UPPER COLORADO RIVER BASIN

RAWLINS FIELD OFFICE

STANDARDS AND GUIDELINES ASSESSMENT

2001 Field Season

Document for Agency, Permittee, and Interested Public Review

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INTRODUCTION

The Upper Colorado River Basin occupies 1,711,621 acres in Carbon and Sweetwater counties in south-central Wyoming, of which 1,504,775 acres are within the Rawlins Field Office. Land ownership consists of 73% federal lands, 22% private lands, and 5% state lands. Federal ownership includes 929,881 acres administered by the Bureau of Land Management and 165,029 acres administered by the United States Forest Service (Map #1).

Land ownership patterns vary from blocked public lands, checkerboard along the railroad right-of-way, to various mixtures of public and non-public lands ranging down to isolated 40-acre tracts of public lands. It is this intermingled ownership and dependency on the health of all lands that has resulted in cooperative efforts like the Muddy Creek Coordinated Resource Management (CRM) group. These efforts were initiated to improve individual allotment management and address watershed issues, which span multiple allotments, issues such as water quality, roads and erosion problems, and fisheries habitat. In 2001, one of the principal goals of the group was accomplished when Colorado River cutthroat trout were reintroduced into Littlefield Creek, an upper headwater tributary to Muddy Creek.

There have been many other successes throughout this watershed over the last fifteen years. Private individuals, livestock operators, non-profit groups, and agency personnel have all contributed to these efforts. In particular, though, the contributions of the Little Snake River Conservation District with support from the Natural Resources Conservation Service, need to be recognized. In project planning and implementation, monitoring, education, and cost-sharing, these groups and their employees have been a tremendous help in improving the resource conditions on public and private/state lands.

The 1996 rangeland reform process modified the grazing regulations to address the fundamentals of rangeland health. In August 1997, the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the Bureau of Land Management in the State of Wyoming* were approved by the Wyoming State Director. The objectives of the rangeland health regulations are to “promote healthy sustainable rangeland ecosystems; to accelerate restoration and improvement of public rangelands to properly functioning conditions… and to provide for the sustainability of the western livestock industry and communities that are dependent upon productive, healthy public rangelands.” The fundamentals of rangeland health combine the basic precepts or physical function and biological health with elements of law relating to water quality and plant and animal populations and communities. Initially the standards focused on livestock grazing on BLM-administered lands, but the standards were developed to apply to all uses and resources.

In the Rawlins Field Office, rangeland standards were assessed on an allotment basis from 1998 through 2000. Some of the allotments contained within this watershed assessment were already evaluated, and that information and determination was just incorporated into this document. However, allotment assessments tend to emphasize management and impacts from livestock grazing, rather than on all uses which occur to and potentially impact public lands. In addition, assessing watersheds, water quality, and habitat for wildlife, fisheries, and threatened and endangered species, often does not correspond to allotment boundaries and is more logically evaluated at a larger scale. In January 2001, Instruction Memorandum No. 2001-079, Guidance for Conducting Watershed-Based Land Health Assessments, was sent to Field Offices from the Director of the BLM. This IM transmitted the 4180 Manual Section and 4180-1 Rangeland Health Standards Handbook and provides guidance for conducting assessments and evaluations for ascertaining rangeland health on a watershed basis. Under Policy/Action it states: "The Field Offices are to consider all assessment requirements for the watershed being assessed and select methods which will provide information needed to fulfill those requirements. When a field office invests its resources in an assessment, the end product should substantially meet all assessment needs to avoid conducting multiple assessments for multiple needs. For example, a well-planned, watershed-based assessment can provide the information needed for allotment evaluations, biological assessments for Section 7 Endangered Species Act consultation, and developing habitat management plans, Water Quality Improvement Plans for Total Maximum Daily Loads on impaired waters, and watershed restoration actions." In order to complete all

Standard Assessments within the original 10-year timeframe, watersheds have been divided into seven units with the upper Colorado River watershed report the first to be completed (see Map #2).

The standards are the basis for assessing and monitoring rangeland conditions and trend. The assessments evaluate the standards and are conducted by an interdisciplinary team with participation from permittees and other interested parties. Assessments are only conducted on BLM-administered public land, however, interpretation of watershed health and water quality may reflect on all land ownerships within the area of analysis. The six standards are as follows:

<u>Standard 1- Watershed Health</u>: *Within the potential of the ecological site (soil type, landform, climate, and geology), soils are stable and allow for water infiltration to provide for optimal plant growth and minimal surface runoff.*

> The standard is considered met if upland soil cover generally exceeds 30% and obvious signs of soil erosion are not apparent, and stream channels are stable and improving in morphology.

<u>Standard 2 – Riparian/Wetland Health</u>: *Riparian and wetland vegetation have structural, age, and species diversity characteristic of the state of channel succession and is resilient and capable of recovering from natural and human disturbance in order to provide forage and cover, capture sediment, dissipate energy, and provide for ground water recharge*.

> The standard is considered met if riparian/wetland habitat is rated in Proper Functioning Condition (PFC) and existing management will lead to maintaining or improving resource condtions.

<u>Standard 3 – Upland Vegetation Health</u>: *Upland vegetation on each ecological site consists of plant communities appropriate to the site, which are resilient, diverse, and able to recover from natural and human disturbance*.

> The standard is considered met if plant communities are sustaining themselves under existing conditions and management.

<u>Standard 4 – Wildlife/Threatened and Endangered Species Habitat Health, Fisheries, Weeds</u>: *Rangelands are capable of sustaining viable populations and a diversity of native plant and animal species appropriate to the habitat. Habitats that support or could support threatened species, endangered species, species of special concern, or sensitive species will be maintained or enhanced*.

> The standard is considered met if habitat needed to support wildlife species is being sustained under existing conditions and management.

<u>Standard 5 – Water Quality</u>: *Water quality meets State standards*.

> The standard is considered unknown unless information provided by the State of Wyoming determines the status of a water body as impaired (not meeting) or is meeting its beneficial uses.

<u>Standard 6 – Air Quality</u>: *Air quality meets State standards.*

> The standard is considered met or impaired based on information provided by the State of Wyoming.

If an assessment shows that a standard(s) is not being met, factors contributing to the non-attainment are identified and management recommendations developed so the standard may be attained. If livestock are contributing to the nonattainment of a standard, as soon as practical but no later than the start of the next grazing season, management practices will be implemented to ensure that progress is being made toward attainment of the standard(s). The rangeland standards established a threshold, however, the desired resource condition will usually be at a higher level than the threshold.

The desired range of conditions portrays the land or resource values that would exist in the future if management goals are achieved. The length of time to achieve the desired range of conditions would vary depending on the resources involved, the management actions required, and the speed at which different resources can effectively change. For instance, improving plant cover and litter, or changing species composition with treatments may be achieved relatively quickly in 5 to 10 years. However, developing a mixed age structure of willows along a stream by changing livestock management may take 20 to 30 years, even though proper functioning condition may already occur. Other actions, such as restoring aspen woodland within lodgepole pine forest communities using prescribed or natural fire, may take 50 years or more.

The following regulatory constraints or special management considerations govern some of the resource values in the area:

- Colorado River Salinity Compact
- Muddy Creek and Savery Creek Clean Water Act Section 319 Watershed Plans
- Conservation Agreement and Strategy for Colorado River Cutthroat Trout in the States of Colorado, Utah, and Wyoming. Conservation Plan for CRCT in the Little Snake River Drainage, Southeast Wyoming.
- Draft Conservation Agreement and Strategy for Three Cypriniform Fishes – Addressing Conservation needs for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker.
- Adobe Town Wilderness Study Area
- Adobe Town Wild Horse Herd Management Area
- Draft Yampa River Programmatic Biological Opinion – Endangered Fish of the Colorado River

The framework for this report will be an introduction and background information, followed by discussion of each rangeland standard in the order described earlier in this document. Within the discussion for each standard will be a map and description of how the standard will be addressed. The outline of discussion for each standard will follow the six-step process for ecosystem analysis at the watershed scale. The six steps are: 1) Characterization of the watershed, 2) Identification of issues and key questions, 3) Description of current conditions, 4) Description of reference conditions, 5) Synthesis and interpretation of information, and 6) Recommendations. Core topics will be discussed under the appropriate standard, with erosion processes, hydrology, and stream channels under Standard 1; vegetation split into wetland/riparian or upland under Standards 2 and 3; species and habitats under Standard 4; and water quality under Standard 5. Human uses would be discussed under each Standard where appropriate. Standard 1 – Watershed Health has been split into seven descriptions for different hydrologic units, while the Standards 2 through 6 are each described as one unit for the entire upper Colorado River watershed.

BACKGROUND

Topography of the basin consists primarily of gentle to moderately-sloping flats and rolling hills, with steep slopes limited to badlands, rims, and canyon walls along drainages. Key landscape features include Kinney Rim on the southwest border, Powder Rim along the Colorado state line, Delaney and Wamsutter Rims in the northwest border, Atlantic Rim on the northeast border, and the Browns Hill plateau, a high elevation bench which stretches 30 miles northward to Miller Hill, along the east side of the basin. Important drainages include the Little Snake River and its tributaries, including Savery Creek, Muddy Creek, and Sand Creek. Elevation ranges from around 6,000 ft along the Little Snake River to 8,400 ft on Miller Hill.

Climate varies greatly depending on the elevation and topography. Precipitation ranges from 7 to 9 inches in the lower desert regions to 10 to 14 inches in the foothills to over 20 inches in the Medicine Bow National Forest (MBNF). Wind plays a large role in blowing open exposed slopes and rims, while depositing snow in deep drifts on leeward slopes which support aspen communities and groundwater recharge for stream flows. The nearest National Weather Service station is at Baggs, where Muddy Creek enters the Little Snake River. Mean annual moisture here is 12 inches, with April through June and September-October being the wettest months. Precipitation occurs as both snow during the winter and rain/thunderstorms during the spring and summer. Mean annual temperature at Baggs is 42 degrees Fahrenheit, with a mean winter temperature of 28 degrees and a mean summer temperature of 66 degrees.

Soils in the basin formed in residuum or alluvium derived dominantly from shales or sandstones. Layers of both these types are often found together in alternating bands of varying thickness. Textures run the gamut from clays to loams to sands and from very shallow to deep. Clay and silt-dominated soils are often saline or alkaline, while sandy and loamy soils have had enough precipitation to leach salts sufficiently to allow them to function (effective rooting depth) as moderate to deep soils. Fine-textured soils have lower infiltration rates and higher rates of runoff with high to severe potential for soil erosion, while loam to sandy soils have moderate to high rates of infiltration and produce low to moderate runoff with low to medium potential for soil erosion. Finer-textured soils will usually have lower amounts of vegetative cover and litter.

Vegetation is predominantly sagebrush-grass communities in this region, with nine species or subspecies of sagebrush shrubs commonly occurring together or in site-specific habitats. The next most common vegetation types are saline-influenced communities, either saltbush steppe or greasewood lowlands and playas. Utah juniper woodlands occur in the 10 to 14-inch precipitation zone where thin soils overlay a fractured bedrock substrate. Mountain shrubs, which include bitterbrush, snowberry, serviceberry, chokecherry, and mountain mahogany, occur in 10-inch or higher precipitation zones and are usually intermixed themselves or with sagebrush and juniper. Aspen woodland is usually found above 7,000 ft in small pockets on north and east-facing slopes where snow accumulates or there is some other source of additional moisture. Riparian and wetland habitats occur on less than one percent of public lands. Herbaceous and shrub-dominated riparian communities are the most common, with tree-dominated habitat such as cottonwood being the least common in occurrence.

Wildlife are abundant and diverse. Antelope, mule deer and elk are common big game species. Greater sage-grouse, Columbian sharp-tailed grouse, and mountain plover are important species of interest. Raptors include golden and bald eagles; ferruginous, red-tailed and Swainson’s hawks; burrowing owls; and other hawks, harriers, and owls. Other commonly observed wildlife are coyotes, badger, beaver, muskrat, cottontail and jackrabbits, prairie dogs, ground squirrels, waterfowl, and songbirds. Fisheries are most recognized for various species of trout, which have all been introduced into streams and ponds for recreational use. Colorado River cutthroat trout historically occurred in this region and have recently been reintroduced into the upper Muddy Creek drainage and in the upper Little Snake River in the MBNF. Increasing attention is being directed at non-game fish species, including threatened and endangered species found lower in the Colorado River drainage and local native fishes such as the roundtail chub, bluehead sucker, and the flannelmouth sucker.

The Adobe Town Wild Horse Herd Management Area (HMA) straddles the boundary line between the Rawlins and Rock Springs Field Offices. The herd’s appropriate management level (AML) is between 600 to 800 wild horses, with the current population at about 2,500 animals. The HMA is a vast, rugged land of sandy washes, rolling hills, juniper rims, and badlands, spread over 445,298 acres and having few fences. It only occupies the western one-third of this watershed assessment.

The Adobe Town Wilderness Study Area (WSA) is also within the same general area as the HMA just described. It consists of 10,920 acres near the center of the Washakie Basin. Adobe Town is bounded on the west by a broad, gently-sloping plain that is covered with stabilized sand dunes and alluvium. The flat terrain of this plain breaks abruptly at Adobe Town Rim into a maze of badlands that form small basins, ledges, and alcoves at lower elevations east of the rim. From a few hundred feet to several miles east of Adobe Town Rim, at still lower elevations, small isolated haystack buttes are located. These give Adobe Town its name and form the area known as Monument Valley.

Human population levels are low, with approximately 1,000 people living in the Little Snake River valley and just over 9,000 people living in Rawlins, the county seat, located about 20 miles north of the basin. Improved roads are limited to the paved state highways and dirt and graveled roads maintained by the county, federal agencies, and, more recently, by mineral development companies. Human use on public lands within the Upper Colorado River Basin is generally related to oil and gas development, livestock grazing, and recreation.

Natural gas development is extensive in the northwest quarter of the basin and is expanding to the south and east, while oil fields occur in just a few small areas. Extensive, undeveloped coalfields have led to the recent exploratory development of coalbed methane on the east side of the Muddy Creek watershed between Rawlins and Baggs. Recent infield development of natural gas fields south of Wamsutter is reaching the density of one well per 80 acres, with lower density development ranging from one to four wells per 640 acres.

There are 104 allotments permitted for grazing use on public lands in the watershed analysis area. Grazing use is approximately 90 percent cattle and 10 percent sheep, with winter or seasonal use at lower elevations and only summer or fall use at higher elevations. Historical use in this area developed primarily as cattle until the harsh winter of 1886-87, which opened the door for sheep to dominate from the 1890s through the 1950s. Cattle numbers have slowly risen through the years, with most conversions to cattle happening in the 1960s through the 1980s. The Taylor Grazing Act in 1934 began a process of creating allotments, which has led to greater stewardship and on-the-ground management. Fencing of allotments has been an ongoing, long-term process, with pasture fencing becoming more common in recent times. Table #1 lists the allotment name, number, and the factors for each allotment, which were used to prioritize monitoring in the standards assessment, and corresponds to Map #3 depicting allotments within the watershed. This table was created using monitoring data, PFC assessments, and professional knowledge, as well as information or knowledge about these allotments from other agencies. Typically, the allotments with the most boxes checked will be the areas needing the most attention.

Recreation use includes hunting, fishing, camping, wildlife-viewing, ORV use, and traveling either the Continental Divide National Scenic Trail or the historic Overland Trail. The numbers of people involved in these activities are generally low except during the fall hunting seasons.

STANDARD 1 – WATERSHED HEALTH

Within the potential of the ecological site (soil type, landform, climate, and geology), soils are stable and allow for water infiltration to provide for optimal plant growth and minimal surface runoff.

The Upper Colorado River Basin in this watershed assessment consists of three fourth order Hydrologic Unit Code (HUCs) watersheds: Muddy Creek, Little Snake River, and Vermillion Creek (Maps #4 & #5). All of Muddy Creek (630,446 acres) is included in this assessment. The portion of the Little Snake River (909,479 acres) in Wyoming and excluding MBNF lands is included in this assessment. The only portion of Vermillion Creek (171,621 acres) is the portion of Shell Creek (5^{th} Order HUC) within Wyoming. Map #x and Table #2 depict the 5^{th} Order HUCs, acreages, and groupings of these watersheds that will be discussed for Standard 1.

Table # 2 – Upper Colorado River Basin 4^{th} and 5^{th} Order Hydrologic Unit Code (HUC)

4^{th} Order HUC	Acreage	5^{th} Order HUC	Acreage	Assessment Name
Muddy Creek	630,446	Upper Muddy Creek	135,232	Upper Muddy Creek
		Barrel Springs Draw	241,238	Barrel Springs Draw
		Lower Muddy Creek	253,976	Lower Muddy Creek
Little Snake River	909,479	Savery Creek	225,616	Savery Creek
		Battle Creek	110,577	Savery Creek
		L. Snake River- Willow Cr	92,243	Little Snake River
		L. Snake River- Powder W	56,863	Little Snake River
		Lower Sand Creek	299,946	Sand Creek
		Upper Sand Creek	124,234	Sand Creek
Vermillion Creek	171,696	Shell Creek	171,696	Shell Creek
Total	1,711,621			

Upper Muddy Creek

1) Characterization:

Upper Muddy Creek contains the perennial headwater streams of Muddy Creek, Littlefield Creek, and McKinney Creek. As it drops in elevation, only ephemeral side drainages add to the creek before its confluence with Barrel Springs Draw. The headwater area is in a 12 to 18-inch precipitation zone with well-developed loamy soils. From the lower end of Littlefield Creek and McKinney Creek downstream, the soils are predominantly shale and clay-loam with higher runoff and erosion potential. Precipitation in the lower portion is between 8 and 12 inches annually. Elevation ranges from 6,500 at the confluence of Muddy Creek and Barrel Springs Draw to 8,200 ft at Rendle Rim and 8,400 ft at Miller Hill at the headwaters of Muddy Creek.

Wide meadows and active floodplains occur on the uppermost perennial and intermittent stream channels and where irrigation has been developed (picture 7-1). The majority of the main channel of Muddy Creek below the headwater areas is incised within 8 to 12 foot tall banks, with all high flow events confined in the channel (picture 7-2). Due to this downcutting and incisement, most erosion occurs from in-channel sloughing on outer banks as the stream widens the active floodplain and from gradient adjustment moving up ephemeral side channels. Average annual flow contributed by the entire Muddy Creek watershed is around 13,000 acre-feet, with only 10,690 acre-feet recorded between 1987-1991. Flows at the lower end of this watershed average between 30 to 50 cfs from March through June. Peak flows are highly variable during this time period, ranging from 150 cfs to 1200 cfs. Flows usually dry up at this lower end by July or August unless precipitation is above average. Flows are perennial out of the headwaters down to about the confluence with Long Draw or CY Draw. Gauging of flows just below the confluence of McKinney Creek and Muddy Creek shows flows in May (just after the peak runoff) of 70-85 cfs to fall base flows of 4-5 cfs.

The majority of stream channels in this watershed are either a C6 stream type or an E6 stream type. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent (picture 8-1). Rates of lateral adjustment are influenced by the presence and condition of riparian condition. The E6 stream type is found where incisement has occurred. Here it is laterally contained in an entrenched valley and evolves to a channel inside a previous channel (Rosgen 1996). This stream type is also a silt-clay dominated, riffle-pool system, with gradients less than two percent creating high meander width ratios, high sinuosities, and low width/depth ratios (picture 8-2). Streambanks are stabilized with riparian vegetation similar to C6 stream types. Two other stream types are also worth mentioning. In the upper headwaters on steeper sloped portions of the Littlefield and McKinney Creek drainages are B4 stream types. This stream type is found in narrow, moderately steep colluvial valleys, with gradients of two to four percent and channel materials composed predominantly of gravel with lesser amounts of boulders, cobble, and sand (picture 8-3). The B4 stream type is considered relatively stable and is not a high sediment supply stream channel (Rosgen 1996). Between two and six miles above its confluence with Barrel Springs Draw, Muddy Creek has been influenced by man-made spreaderdikes and irrigation systems since the early 1900s. These activities have created broad depositional areas reaching ½ mile or more in width and a D6 stream type. The D6 stream type is a multiple channel system found within broad alluvial valleys consisting of cohesive silt-clay depositional materials (Rosgen 1996). Channel gradients are very low, with excessive deposition and annual shifts of the bed location (picture 8-4). It may take several years for vegetation to stabilize new depositional areas.

Principal human uses in the headwaters area are livestock grazing and recreation. Livestock use is primarily cattle, employing both cow/calf and yearling operations. Seasons of use at lower elevations are spring through fall with snow usually precluding year-round use. Season of use at higher elevations is usually from mid-May or June through September or October. Recreation is primarily related to hunting, fishing, or using the Continental Divide National Scenic Trail. The highest use period is during the fall hunting season (September through October). Associated with this use is an improved/unimproved road transportation system and off-highway vehicle use. In the lower half of the watershed are the previously described human uses and oil and gas field development, along with recent exploratory development for coalbed methane.

2) Issues and Key Questions:

Many of the issues and key questions within each watershed assessment area are similar, therefore they will be discussed in their entirety, and if there are additional specific concerns, they will be noted. In addition, they are listed in priority of importance.

1. Livestock Grazing: Livestock grazing has been and continues to be the principal factor affecting watershed values in the Upper Muddy Creek watershed (picture 8-5). Management issues relate to the season, duration, and distribution of use rather than stocking rates. These issues are primarily directed at impacts to stream channels, which affect bank stability and width/depth ratios. The key question is what further refinement in best management practices for livestock grazing or other actions need to be made to improve watershed health and meet desired resource conditions.

2. Erosion: Erosion from roads, both improved and unimproved, is the second most important factor relating to watershed health. The BLM, Carbon County, and various oil and gas companies all maintain improved roads within the watershed. The principal problem with improved roads is inadequate water control features, such as culverts, wing-ditches, and water-bars, to mitigate the effects of roads on upland runoff hydrology (picture 8-6). Road standards are based on how to build and maintain a safe road, rather than what effect the road has on altering the natural hydrology of the landscape. As a result, roads tend to collect water off a broad area and then release it in a more concentrated volume, in a draw or flared onto a hillside undeveloped for this flow, causing accelerated erosion (picture 8-7). For each mile of improved road there are probably ten miles of unimproved roads or two-tracks. Many of these two-tracks do not cause increased erosion, but where it does occur there is usually no maintenance to correct the problem. Use of road systems by all users, particularly in bad weather or when roads are wet, leads to increased erosion from roads. The increasing use of this country for recreation, and the increasing use of 4-wheel drives and off-highway vehicles, is creating new roads and new sources of erosion. The key questions here are: How do we improve the adequacy of water control features on improved roads? How can erosion sources from two-track roads best be addressed? What educational and management tools should be employed to reduce erosion impacts from recreation and other users of public lands?

3. Oil and Gas: Oil and gas field development is increasing in this watershed and across the region. Short and long-term sources of erosion are increasing with this development, but can often be mitigated with good reclamation practices. This is especially true for pipelines and more recently for active and reclaimed pads involving BP America (picture 9-1). However, most other companies are not performing the quality of pad reclamation to reduce impacts of mineral development on soil erosion. The key question is how to elevate the attention to reclamation by all mineral development companies to that achieved by BP America.

4. Woody Plant Health: The age and canopy cover of big sagebrush, mountain shrub, and juniper woodland plant communities is increasing, leading to lower herbaceous ground cover and water yield. Older shrub and tree communities use more water, have lower infiltration rates and greater surface erosion, all leading to reduced late-season stream flows. Prescribed burns conducted in this and adjacent watersheds have shown improvements in ground cover, reduced surface erosion, and improved late season stream flows. The key question is: How do we as an agency decide on what amounts of treatments should occur to promote higher stream flows and lower soil erosion levels and still address all of the resource values that we are obligated to manage?

3) Current Conditions:

Quantifiable data about current erosion levels and stream flows, as well as condition and trend, is not available. However, information from photo-points, channel cross-sections, and personal observations show that the trend for watershed values is upward. Specific management actions, grazing systems, range improvements, vegetative treatments, etc., will lead to improved resource conditions.

Stream channels are narrowing, with banks becoming more stable with perennial, deep-rooted vegetation. As the channels narrow, the active floodplain width expands, including within incised banks where the upper slopes continue to widen and become more stable with vegetative cover. In-channel bank sloughing on outer corners and gradient adjustment of ephemeral side drainages are the primary sources of erosion. In a few locations, this includes gully movement through the dams or spillways of old reservoirs. Hydrologic function is improving due to the above-mentioned changes in stream channels and floodplains. However, the general lack of beaver ponds in this system results in faster movement of flow events and reduced water storage for late-season stream flow.

The meadow complex located in the vicinity of the George Dew homestead at the lower end of this watershed has a great influence on stream flow and erosion. Created during the early and mid-1900s, and more recently maintained, this four-mile long and ½-mile wide wetland/riparian habitat both stores water and catches sediment from upstream sources. Stream gauging in 1987 recorded water storage in this meadow complex of 10,000 acre-feet of water. The low gradient and perennial vegetation act as a filter to remove sediment eroded from sources higher in the watershed.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. In the headwaters area, cover and litter range from 70 to 80 percent in big sagebrush communities to over 90 percent in aspen and serviceberry communities. At lower elevations, cover and litter in sagebrush communities range from 50 to 60 percent, with only 30 to 40 percent in saltbush steppe and juniper woodland communities. The lowest amounts of cover occur in greasewood/playa locations. This is primarily a function of the natural conditions, going from wettest to driest.

The primary natural type of disturbance occurring in this watershed is beaver activity (picture 9-2). Habitat for beaver (large woody material like aspen, willows, and waterbirch) is limited, probably due to historic grazing by livestock and other practices that reduced willows, such as lack of fire needed to regenerate aspen and downcutting and gradient adjustment processes. There is one larger active complex in lower

Littlefield Creek canyon, which is supported by healthy communities of waterbirch and Booth and Geyer willows. However, most streams have little woody plant species. The few beaver which occur elsewhere in the watershed tend to move into a stretch of creek, build one or two dams until the present material is exhausted, then move on to a new area the next year when their little dams wash out during spring runoff. This process initially appears to be pointless and just sets back the existing, struggling willows. Upon closer scrutiny, this process helps saturate upper banks that collapse into the stream, thereby helping to widen the floodplain, expand riparian habitat, and supply sediment to build and narrow banks downstream. The sediment caught behind the dam becomes a seedbed for new willows and a more diverse community of early succession species, which in a few years will be taken over by the more dominant sedges and grasses. Existing willows will regrow until the cycle repeats itself.

4) Reference Conditions:

Howard Stansbury, an army topographer, made the earliest documentation of the Muddy Creek watershed in 1850. Stansbury reached Muddy Creek on September 18, making camp about 25 miles north of Baggs. He wrote: “The only vegetation at this camp was a few scattering clumps of small willows and some black currant-bushes, the supply of grass was scanty. Muddy Creek runs between perpendicular cut clay-banks, forty feet apart, the water at the present stage being only four feet wide and four inches deep.” On the following day, moving upstream he wrote: “The ground was rough and filled with gullies made by the rush of the spring freshlets. The soil was loose and sandy, and the waters had cut numerous deep and narrow channels across the valley, whose perpendicular banks obliged us to pass along the base of the bluffs, in order to head, and thus avoid them. The creek had to be crossed some six or eight times, and, upon the whole, this has been the roughest and most difficult part of the route.” That night the party camped along Muddy Creek near Sulphur Springs. Stansbury wrote: “We turned down into a pretty little bottom, fringed with willows, currant-bushes, and birch, and encamped having made only fourteen miles. We found the creek filled, at short intervals, with beaver dams . . . . The stream furnishes some small fish, among which were speckled trout.”

Lieutenant F. T. Bryan in 1856, in charge of the Bryan Wagon Road Survey, wrote in crossing over from Sage Creek Basin to Muddy Creek: “The thick growth of sage was very much in our way, obstructing the passage of the wagons, and fatiguing men and animals very much. The water in Muddy Creek was running slowly, some trout were taken in the pools of Muddy Creek. The only grass in this part of the country lies along the small streams, where they issue from the hills. We found it necessary to herd our animals on those spots . . . no one place having sufficient for the whole of them. On this account, a large train could scarcely travel through this country, much less remain any time in it.”

In December of 1857, John Bartletson traveled up Muddy Creek towards Sulphur Springs and wrote: “After traveling about five miles we came to a canon with high mountains on each side, which it would be impossible to pass. It would be very difficult to pass through having to cross the creek three times in about half a mile, which has very steep banks and a deep muddy channel, which would have to be bridged to allow anything like a wagon pass. We found after about one mile through this canon that the bottom got wider, with very tall sage brush, which is very bad to get through, crossed a great many bad ravines, and came to one in particular which would have to be bridged . . . .” The next day, passing above Sulphur Springs, Bartletson wrote: “Crossed the creek three times in about a mile on account of the hills being too steep to cross; these crossings are very bad, the banks of the creek being about fifteen feet high, with two or three feet of water in the channel, bottom very miry; we there took the hill side for about two miles, which was very good. We then came to another canon, where the high mountains came entirely down to the creek, where we would have to cross the creek again about ten to twelve times if we came up the canon; but we found the crossing too bad to cross with pack mules, and we took along the mountain sides in a narrow lodge pole trail which crosses very deep ravines every few yards, hill side very steep.”

These accounts and others indicate that Muddy Creek flowed between high perpendicular banks that were hard to cross by travelers, and that side ravines and tall thick sagebrush were common. Stream vegetation, particularly grass for forage by saddlestock, was spotty and scant in many places (pictures 10-1, 10-2). The channel bottom was miry and difficult to cross except on rock riffles. Beaver ponds and willows appear to be common upstream from Sulphur Springs, but only occurred in isolated clumps below Sulphur Springs.

5) Synthesis and Interpretation:

From the historical accounts described above, in-channel and upland gully erosion are common, naturally-occurring processes, which attributed to how Muddy Creek got its name. The tall, dense sagebrush, which was so hard to get wagons through, would indicate the general lack of fire in this area for a long time. The isolated clumps of willow, observed below Sulphur Springs, are not so different than what is present today. However, the significant difference is the presence of beaver dams and speckled trout, which require habitat parameters that are not present in much of the watershed at this time. An interesting side-note to this is the general lack of forage for saddle stock, even apparently along the creek. Does this indicate concentrated grazing by wildlife due to limited sources of water, and would this influence the ability of riparian vegetation to stabilize stream banks? Regardless of this question, the riparian habitat in the 1850s was not described as the lush mix of willows, sedges, and grasses that we see now and know is within our capabilities to manage for.

What have been the changes in the watershed over the last 150 years? The answer is obviously livestock grazing, as well as irrigation of private lands along Muddy Creek; removal of willows and trapping out the beaver, which in some cases were promoted by government agencies and policies; and the public perception (via Smokey Bear) that fire and fire effects are all bad. Motorized vehicles and roads to access the country has also helped change the landscape around us. All of these factors influence resource conditions and all can be manipulated to achieve desired results.

Impacts from historic sheep use relate primarily to areas where sheep were concentrated or repeatedly used, such as bed grounds, lambing sites, and adjacent to reliable water located between the foothills and the desert where extensive use in the spring and fall months was made. These areas are spotty in occurrence and typically have a higher percent bare ground, compacted soils, produce more runoff, and support more invader and increaser species like cheatgrass, annual forbs, and prickly-pear cactus. These areas are slowly healing with an increase in perennial grass species and cover.

Impacts from historic and current cattle use relate to duration and distribution of use and the lack of pasture fencing or herding to control them. In many cases, the lack of reliable upland water sources and thick brush on the deeper soils in the valley bottoms also contributed to cattle spending too much time along streams and riparian systems. This promoted overuse of deep-rooted sedges, grasses, and willows, leaving bare ground or shallow-rooted, grazing resistant species like Kentucky bluegrass which does not hold stream banks together well. As a result, in-channel erosion increased, bank stability decreased, and stream channels became wider and shallower. This in turn reduced the water storage capability of the riparian system leading to higher peak flows and lower late season stream flow.

Other factors contributed to the degradation of these riparian systems. Flow alterations for irrigation will raise the floodplain as sediment loads are deposited, and channels below diversion points will narrow in response to lower flows. When irrigation no longer occurs, these raised floodplains become sediment sources for the stream flow to cut through and move somewhere else. The narrowed channel below the diversion must widen to accommodate the increased flow levels. Both of these actions can cause head-cuts to occur in a gradient readjustment process that increases erosion. Although irrigation is on private lands, the impacts from head-cutting often move onto or affect adjacent public lands. The control of willows and beaver to increase the amount of water and space available for livestock use has just the opposite results. Reliable, long-term supplies of water come from slowing it down and storing it in banks and pools, which is just what beaver do.

Wildfire suppression policies and actions have created negative impacts to both fire-stimulated species like aspen and chokecherry and fire-sensitive species like big sagebrush. Aspen are a fast growing species, providing the largest and most durable building material for beaver dams. The relationship between beaver and aspen is critical to maintaining riparian systems, in terms of stream flows and stability due to large woody debris. Only half of the aspen present in 1938 are still here today, and that is largely due to lack of fire in this ecosystem. Fire-sensitive species like big sagebrush have become decadent with higher canopy cover. This results in lower species diversity and lower herbaceous cover and production, creating more surface runoff and soil erosion. Fire, therefore, is a necessary component of a healthy, functioning watershed.

And last, but not least, are the problems associated with roads and off-highway vehicle use. Improved roads are needed to access the country for the different uses people have in either making a living or enjoying our public lands. Identifying and fixing problems associated with these roads can and should happen (picture 12-1). The tougher issues deal with using roads when they are wet or impassable, which results in tearing them or the country up and increasing soil erosion. The other increasing problem is off-highway use, which results in creation of new roads, with tracks and ruts, which catch and funnel water leading to new gullies and new sources of erosion. People who try to cross streams where the banks or channel are too soft can also increase erosion. There appears to be a real need for public education about vehicle use, erosion, and how users' decisions and practices affect the public lands they want to enjoy.

Initial attempts to address resource issues associated with livestock grazing involved development of allotment management plans (AMPs) in the 1960s. However, emphasis on improved management of wetland and riparian habitat was lacking. More recent attention to these AMPs in the 1980s and expansion of these efforts to a watershed scale through the Muddy Creek CRM in the early 1990s has led to significant improvement in resource values.

Management changes relating to livestock grazing include: pasture grazing systems to control duration of use, deferment of riparian pastures to late summer or fall use when possible, development of upland water sources to reduce dependence on streams as water sources, and prescribed burns on uplands to reduce dense brush and increase forage production, availability, and palatability. Improvements relating to roads include: installation of new stream crossings, additional culverts, replacing straight culverts with drop-culverts, waterbars, roadside pits, and closure of a few roads on steep slopes and where two roads reach the same point (picture 12-2). Other actions taken include instream structures for gradient control, vegetative plantings to speed up the rate of bank stabilization and, at the lower end of the watershed, reconstruction of two gradient control dikes/diversion structures and construction of four new spreader-dikes (picture 12-3).

These changes in management and range improvements, implemented over the last 15 years, have resulted in the following improvement in resource conditions. In most locations, surface stream width (at base flows) has been reduced by 50 percent or more. Graphs #1 and #2 and pictures 12-4 thru 12-7 show change in stream channel morphology from Littlefield Creek and Muddy Creek. The figures and pictures both show reduced width/depth of the channel, interior bank building and stabilization with perennial riparian vegetation, and flows at both locations are at higher levels during late-season low flow periods than they were previously. Vegetative bank cover has increased significantly, starting at 25 percent or less and currently exceeding 90 percent. Photographs x through y show locations on Muddy Creek which have stabilized with vegetation and, therefore, reduced the unprotected bank area vulnerable to in-channel erosion. This is supported by observations of turbidity, which is only seen now during high runoff and after storm events compared to being commonly observed on a year-round basis prior to management changes. The bank building and expansion of riparian habitat (due to narrowing of stream channels), in addition to vegetative treatments, have led to increased late-season flows in all perennial streams.

Improvements to roads have led to healing and reduced occurrence of gullies along roads. Water flows are spread into the vegetation where it benefits plant growth and infiltrates the soil instead of running down the middle or side of the road until it reaches a stream. Improved or closed-off stream crossings have reduced vehicular disturbance to channels and banks (picture 12-8). Drop-culverts have eliminated the large splash holes below roads, leading to lower erosion and vegetative stabilization along these ephemeral channels (picture 12-9). There is still a need for further work on nearly all improved roads to reach an adequate level of practices to minimize or eliminate overland flow alterations and erosion caused by roads. Prescribed burns have also helped to heal gullies and increase water infiltration by replacing decadent shrubs with herbaceous vegetation and litter.

Several types of gradient control structures have been constructed, from steel or plastic sheet-piling to fish barriers to repairing old earth berm spreader-dikes. These structures have stabilized active headcuts, reduced in-channel erosion, restored water levels in old floodplains, and accelerated the process of vegetation stabilization on these sites (pictures 13-1, 13-2). In the lower part of the watershed, new spreader-dikes have expanded the width of the functioning floodplain, which dissipates the impacts of high flow events and increases water storage within the system.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing and improving trend in stream vegetation and channel morphology, the cooperation exhibited in livestock management by permittees, and the generally small number of management issues still remaining to be dealt with, it is determined that the majority of Upper Muddy Creek watershed is meeting Standard #1. The few locations that do not meet Standard #1 contain large, active headcuts due to gradient readjustment processes. These areas affect approximately 2,500 acres in Holler Draw and upper Muddy Creek. Current livestock grazing practices are not contributing to the nonattainment of Standard #1. However, where headcuts are associated with water developments in need of maintenance, permittees may be assigned responsibility to help correct these spot problems. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats (picture 13-3). Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Continue to eliminate or control active headcuts, along with the necessary livestock management, in order to promote long-term, vegetative stabilization of these sites.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed. Possibly move from an existing roads and trails policy to a designated roads and trails system.

Continue to implement vegetation treatments to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Expand public education about its role in public land management, particularly regarding impacts from roads and off-highway vehicular activities.

Barrel Springs Draw

1) Characterization:

Barrel Springs Draw is a large ephemeral watershed, containing numerous draws and the Red Lakes enclosed basin, that empties into Muddy Creek about 20 miles north of Baggs, Wyoming. In addition to Barrel Springs Draw, which splits into the north and middle forks, other drainages include Coal Gulch Draw, Windmill Draw, South Barrel Springs Draw, and Wild Rose Draw. The lower end of Barrel Springs Draw is sometimes referred to as Red Wash, due to the red soils found there. The entire area is in a 7 to 9-inch precipitation zone with predominantly shale and clay-loam soils, which can produce high runoff with medium to severe erosion potential (picture 13-4). Topography is flat to gently rolling landscape for the most part, becoming moderately-steep to steep close to rims and badlands. Elevation ranges from 6,500 at the confluence of Barrel Springs Draw and Muddy Creek to 7,500 ft at Delaney Rim and 7,600 ft at the Haystacks in the northwest corner and 7,400 ft on West Flat Top on the southern border (picture 13-5).

Due to low topographic relief and infrequent flow events, channel formation varies widely. In the gentler terrain, floodplains are wide with channels hardly recognizable as slight depressions. Where slopes are higher, wide floodplains may still exist but with channels cut several feet in width and depth. In some locations the channels and floodplains are confined within incised high banks. Erosion sources include both uplands and in-channel. Flows in this watershed derive from winter snow or summer and fall thunderstorms. Peak flows usually occur in February or March when temperatures rise and snow melts across the whole watershed in a short period of time. Average annual flow contributed by the entire Muddy Creek watershed is around 13,000 acre-feet, with only 10,690 acre-feet recorded between 1987-1991. Flows are erratic and short-term, with no recording of perennial flows.

The only site with stream flow where channel classification was determined was a two-mile stretch of Middle Barrel Springs Draw, which is a C6 stream type, and a mile stretch of North Barrel Springs Draw, which is an E6 stream type (picture 14-1). The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent. Rates of lateral adjustment are influenced by the presence and condition of riparian condition (picture 14-2). The E6 stream type is found where incisement has occurred. Here it is laterally contained in an entrenched valley and evolves to a channel inside a previous channel (Rosgen 1996). This stream type is also a silt-clay dominated, riffle-pool system, with gradients less than two percent creating high meander width ratios, high sinuosities, and low width/depth ratios. Streambanks are stabilized with riparian vegetation similar to C6 stream types.

Principal human uses in this watershed are natural gas development, livestock grazing, and recreation. Natural gas development has occurred in the area for many years. However, it has expanded in scope of area as well as in-field drilling over the last 10 years (picture 14-3). On the north end of the watershed closest to Wamsutter, well density is reaching an 80-acre spacing, whereas in most areas 160-acre spacing is more common. Livestock use is primarily cattle, both cow/calf and yearling operations. Sheep use also still occurs on a few allotments. Seasons of use for livestock vary by allotment. Winter use is somewhat dependent on annual climate conditions. Recreation is largely related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Erosion- (please refer to issues identified for Upper Muddy Creek on page 7)

2. Oil and Gas-(please refer to issues identified for Upper Muddy Creek on page 8)

3. Livestock Grazing- In addition to the issues mentioned in Upper Muddy Creek earlier, impacts are more related to plant cover and litter values compared to percent bare ground with less emphasis on stream channel impacts.

4.Woody Plant Health-(please refer to issues identified for Upper Muddy Creek on page 9)

3) Current Conditions:

Quantifiable data about current erosion levels, stream flows, and range condition and trend, are not available. Stream flow data for Barrel Springs Draw was collected by the University of Wyoming in the mid-1980s to the early 1990s. Other information is available from photo-points, upland cover transects, and personal observations.

Stream flow information is calculated by subtracting data collected at the Dad station (1½ miles above confluence of Muddy Creek and Barrel Springs Draw) from the Snyder Gas Pad station (located ¼ mile below the confluence of above two watersheds). Monitoring at these two sites was collected between March and November, which correlates to ice-free conditions in the spring and when the channel goes dry in the fall. Unfortunately, high flows from Barrel Springs Draw often occur before the ice melts out of Muddy Creek. Stream flows were documented between 1986 and 1991. During this time period, the driest year was 1986 with almost zero runoff recorded. The wettest year was 1987, when mean daily flows in

April were 43.5 cfs, with a peak daily flow recorded on March 8 of 457 cfs. The months of March and April generally have the highest mean daily flows, while the months of August and September usually have zero or very low mean daily flows. Flows are flashy due to the low amount of vegetative cover and the fast rate over a large amount of land that runoff

Stream channels are well vegetated in the few areas with yearlong or long-term water flow. Most channels are ephemeral and are moderately vegetated with rhizomatous wheatgrass, basin wildrye, big sagebrush, and other upland species. Larger channels tend to have rounded banks with wide floodplains in gentle topography, with steeper banks and confined floodplains where gradients are higher. Most erosion occurs from confined, in-channel sites and from rill and gully erosion from uplands. Much of this is considered background or natural rates of erosion, compared to accelerated rates of erosion caused by impacts from roads or poor grazing practices.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover of 30 percent, while sediment yield increased dramatically when cover declined to less than 30 percent (Linse, Smith and Trlica, 1992). Ground cover ranges from 50 to 75 percent on big sagebrush plant communities to 28 to 45 percent on saltbush steppe plant communities, the two most common vegetation types in this watershed. Greasewood flats and playas are in the 20 to 30 percent range. While this would appear to meet the conditions listed above for accelerated sediment yield, this is not the case, since these sites are on flats and are often the endpoints for water flow off adjacent slopes. The water will pond on these sites with nearly a sealed soil surface due to salts and clays, resulting in most of the water leaving the site as evaporation. This is particularly true for the Red Lakes area in the north part of the watershed and within a closed basin. In general, the overall ground cover appears good, but in many locations can still be improved with the use of Best Management Practices (BMPs).

4) Reference Conditions:

When Howard Stansbury traveled up Muddy Creek in 1850, he also crossed Barrel Springs Draw after he left Bitter Creek and before he arrived on the banks of Muddy Creek. He initially came down the valley of North Barrel Springs Draw and wrote the following. “From this landmark (The Haystacks) we traveled in nearly an eastern direction, gradually descending, for six miles, to the valley of a small branch of Muddy . . . and encamped in its valley, although the water was so strongly impregnated with alkali that the animals drank it with evident reluctance and disgust. The valley is here much cut off by abrupt gullies and ravines, formed by the wash from the hills, and in many places the ground is covered by a crust of impure soda to the depth of half an inch. The grass, since our noon halt, has been very scarce, and our poor mules have fared rather badly.”

The next day Stansbury wrote: “Our course lay down the valley . . . for three and a-half miles, when it opens suddenly between two high cliffs of red and green indurated clay . . . . To this opening we gave the name of Red Gate.” This would have been where North Barrel Springs Draw passes through Delaney Rim and then turns south towards the Flat Tops. He then wrote: “The little stream whose valley we had followed to the Gate, pursued a wandering course to the south-east through the prairie, its existence marked only by an occasional clump of willows. A few buffalo bulls were quietly grazing upon the plain, and now and then a small herd of antelope, bounding away over the hills, gave life and spirit to the picture. The soil from this point to Muddy Creek is for the most part of an excellent quality, but, from want of moisture, can never be appropriated to any other purpose than grazing. The grass, though thin, is very nutritious. Small sage, salt grass, greasewood, a purple aster, together with bunch-grass, and, in the more sandy portions, small cacti, were the principal plants.”

This account and others describe the alkali around the seeps in North Barrel Springs draw and the ravines in this area. They also describe the gently rolling hills between Delaney Rim and Muddy Creek, with thin grass some years and lush grass other years, but available forage for stock, even if they had to travel a few miles away from the trail to find it. This was probably due in part to the variability in moisture and vegetation that occurred each year.

5) Synthesis and Interpretation:

The account described above is similar to what could be observed today in terms of landscape and vegetation. The principal changes are the roads, gas wells, and fences relating to the existing land uses. Road improvements are probably the most visible recent change seen in this part of the Muddy Creek watershed. This includes gravelling some of the more-frequently used roads used by industry, and using additional culverts and wing-ditching. There is still a large need for further work on nearly all improved roads to reach an adequate level of these types of practices to minimize or eliminate overland flow alterations and erosion caused by roads (pictures 16-1, 16-2). This issue is getting larger rather than smaller, with the creation of more roads associated with expanding development of natural gas fields.

The other visible change has been the reclamation efforts around operating wellheads, particularly by BP America, to reduce bare ground that is exposed to wind and water erosion. Other oil and gas companies involved in the same type of work and resource impacts have not reached the same level in their reclamation (pictures 16-3, 16-4). Reclamation of pipelines and dry hole locations is generally good.

Management changes relating to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution. These practices have been occurring over the last 50 years as sheep permits were converted to cattle. Historic sheep use in this area generally took place between late fall and early spring (dormant period of plant growth) when there was adequate snow, since water developments were not present. Too much snow or lack of snow would limit the annual amount of sheep use. This appears to have left plant cover and species composition in good condition. The principal area of impact, still observable today, is the old trail and bed grounds near Dad at the lower end of Barrel Springs Draw. Sheep herds would be sheared and cross Muddy Creek here, which led to a confined trail area with a waiting period to get through. Plant cover and species composition, as well as soil compaction, were negatively affected by this impact, with site recovery still occurring.

Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. New water developments are used to improve livestock distribution and to create more reliable water sources, in order to get through periods of drought. Oil and gas field development has also contributed significantly to creating new sources of water, which are usually made available for livestock and wildlife use. Control of livestock is also complicated by mineral development activities, which can involve lack of maintenance on cattle-guards, leaving gates open or fences down, and inadequate construction techniques.

On the south side of South Barrel Springs Draw are several large reservoirs and approximately 3,000 acres of upland spreader-dikes dating back to watershed improvement work completed in the 1950s and 1960s. A watershed plan developed in the early 1950s for the entire Muddy Creek watershed identified the area from South Barrel Springs Draw down to Cottonwood Creek, which drains east off the Flat Tops, as most in need of action to address watershed values. These projects helped to slow water runoff and promote vegetative cover to reduce soil erosion. They are still largely intact and have received some maintenance attention in the 1990s, but more attention is still needed.

Other improvements include the construction of several spreader-dikes adjacent to Red Wash, just above Muddy Creek, to create wetland and riparian habitat. These projects have only a small impact on watershed values. They blocked off several small drainages, which will reduce upland and channel erosion by a small amount. The water flow that enters Red Wash from these dikes may increase vegetative cover along the last mile of channel before it enters Muddy Creek, which should reduce in-channel erosion.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Barrel Springs Draw watershed is meeting Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole, however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, which minimize the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Lower Muddy Creek

1) Characterization:

Lower Muddy Creek is a large, mostly-ephemeral watershed, which begins at the confluence of the Upper Muddy Creek and Barrel Springs Draw watersheds and ends where Muddy Creek empties into the Little Snake River at Baggs, Wyoming. Muddy Creek is intermittent to perennial in nature, depending on annual and long-term climate conditions. The headwaters of several tributaries on the east side of the watershed are also intermittent to perennial, including Cow Creek, Deep Gulch, Wild Cow Creek, Cherokee Creek, Deep Creek, and the lower portion of Cottonwood Creek on the west side of the watershed (picture 17-1). Principal ephemeral draws are Dry Cow Creek, Blue Gap Draw, Robber's Gulch, and Little Robber's Gulch. The lower elevations in the north end of Lower Muddy Creek are in a 7 to 9-inch precipitation zone. As you move up in elevation and south towards Baggs, precipitation increases into the 10 to 14-inch zone. North and east slopes which blow in with snow at the highest elevations are in a 15 to 19-inch precipitation zone (picture 17-2). Soils are predominantly shale and clay-loam soils, which can produce high runoff with medium to severe erosion potential. The exception to this are the Sandhills in the upper end of the Dry Cow Creek drainage, which have deep sands with excellent infiltration and low runoff and erosion potential. Topography is flat to gently rolling landscape at lower elevations, becoming moderately steep to steep close to rims and badlands and at higher elevations. Elevation ranges from 6,250 ft at Baggs to 7,800 ft at North Flat Top on the west border and Browns Hill on the east border to a maximum of 8,200 ft at Rendle Rim and the headwaters of Deep Gulch and Wild Cow Creek drainages.

Channels are weakly-formed in ephemeral drainages, and moderately to well-formed in intermittent and perennial drainages. At the upper ends of drainages, floodplains are broad and gentle with no channel confinement. However, the lower portions of side drainages and the entire Muddy Creek channel are confined within incised high banks. These may reach 12 to 15 feet in height. Erosion sources include in-channel mass wasting, side channel gradient adjustment, and some upland soil erosion. Flows in this watershed derive from winter snow or summer and fall thunderstorms. Peak flows usually occur in February or March from low elevations and in April or May from the higher elevations. Average annual flow contributed by the entire Muddy Creek watershed is around 13,000 acre-feet, with only 10,690 acre-feet recorded between 1987-1991. Flows are similar to the lower end of the Upper Muddy Creek watershed, with an average of 30 to 50 cfs from March through June, becoming dry in late summer or fall depending on climate conditions. Peak flows are highly variable, ranging from 150 cfs to 1500 cfs.

Stream channels in this watershed are classified as either a C6 stream type, typical of upper headwater drainages, or an E6 stream type, characterized by Muddy Creek. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent (picture 18-1). Rates of lateral adjustment are influenced by the presence and condition of riparian condition. The E6 stream type is found where incisement has occurred. Here it is laterally contained in an entrenched valley, and evolves to a channel inside a previous channel (Rosgen 1996). This stream type is also a silt-clay dominated, riffle-pool system, with gradients less than two percent creating high meander width ratios, high sinuosities, and low width/depth ratios. Streambanks are stabilized with riparian vegetation similar to C6 stream types (picture 18-2).

Principal human uses in this watershed are oil and natural gas development, livestock grazing, and recreation. Oil and gas development has occurred in the area for many years. However, it has expanded in scope and density over the last 10 years. There is currently exploratory development for coalbed methane resources on the east portion of the watershed. Livestock use is primarily cattle, employing both cow/calf and yearling operations. Sheep use still occurs on a few allotments. Seasons of use for livestock will vary by allotment and range from spring through fall. Recreation is mostly related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Livestock Grazing- (please refer to issues identified for Upper Muddy Creek on page 7)

2. Erosion- (please refer to issues identified for Upper Muddy Creek on page 7)

3. Oil and Gas- (please refer to issues identified for Upper Muddy Creek on page8)

4. Woody Plant Health- (please refer to issues identified for Upper Muddy Creek on page 9)

5. Gradient Adjustment: Gradient adjustment is occurring up side drainages to Muddy Creek and in the old upland spreader-dikes. Soils in these areas often have high to severe limitations for use in construction and have high potential for piping. The key question is how to best address this active gully erosion to reduce sedimentation into the upper Colorado River watershed.

3) Current Conditions:

Quantifiable data about current erosion levels and stream flows, as well as condition and trend, are not available. However, information is available from photo-points, channel cross-sections, and personal observations, which show that the trend for watershed values is upward. Specific management implemented along with range improvements and vegetative treatments, at least indirectly, should also relate to improved resource conditions.

Stream channels are narrowing, with banks becoming more stable with perennial, deep-rooted vegetation. The principal exception to this is in the Cherokee allotment where long duration cattle use still occurs, compared to the East Muddy allotment to the north (see graph #3 and pictures 18-3, 18-4). As the channels narrow, the active floodplain width expands, including within incised banks where the upper slopes continue to widen and become more stable with vegetative cover. In-channel bank sloughing on outer corners and gradient adjustment of ephemeral side drainages are the primary sources of erosion. Where detention dams have been constructed, either for watershed purposes or livestock waters, active head-cuts have been stopped and healing of these channels is occurring. On drainages without any dams with drop pipes, active head-cutting continues. Wild Horse Draw in the Cherokee allotment is a good example, and there are a number of sites in the Cottonwood Creek, Robbers' Gulch, and Little Robbers' Gulch drainages. Hydrologic function is improving due to the changes mentioned above in stream channels and floodplains. However, the confinement of channels within incised banks still contributes to faster movement of flow events and reduced water storage for late-season stream flow.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover of 30 percent, while sediment yield increased dramatically when cover declined to less than 30 percent (Linse, Smith and Trlica, 1992). In the headwaters area, cover and litter range from 70 to 80 percent in big sagebrush communities to over 90 percent in aspen and serviceberry communities. At lower elevations, cover and litter in sagebrush communities range from 50 to 60 percent, with only 30 to 40 percent in saltbush steppe and juniper woodland communities. The lowest amounts of cover occur in greasewood/playa locations. This is primarily a function of the natural conditions, going from wettest to driest. However, livestock management practices will influence which side of the range for each community type the data tends to fall within.

Stream flow information was collected for several years near the mouth of Muddy Creek. The channel at this point with bank-full conditions will hold about 1200 cfs before flows start spilling onto private land meadows. As stated above, average flows and peak flows are similar to those measured or observed at the lower end of the upper Muddy Creek watershed. Although the drainage expands in size as you move downstream, much of the water infiltrates into the streambed, making Muddy Creek a losing stream (Goertler 1992). The months of March and April generally have the highest mean daily flows, while the months of August and September usually have zero or very low mean daily flows. Flows are flashy on the west side drainages and the lower elevations of the east side drainages due to the low amount of vegetative cover and the fast rate over a large amount of land that runoff. The higher elevations of east side streams, such as Cow, Wild Cow, Cherokee, and Deep Creeks, have higher amounts of cover and generally do not produce the high, flashy flows. Stream banks are well-vegetated with broad floodplains that store and help slow down high runoff events. Snow pack and drifts in these upper drainages also melt at a slower rate, which largely infiltrates into the soil and adds to later season flows.

4) Reference Conditions:

There are no historical references for pre-settlement conditions in the Lower Muddy Creek watershed. In 1983, Sid Weber spoke about growing up in Baggs during the early 1900s and what he recalled about lower Muddy Creek. Prior to the mid-1920s, the channel width of Muddy Creek was narrow enough for a rider on horseback to jump across. This likely would relate to a channel width of no more than four feet. In the mid-1920s, the creek started to down-cut, a process which was further exacerbated by the drought in the 1930s. This probably follows the peak in sheep numbers in Carbon County that occurred around 1911, and which continued to decline from over half a million to only 20,000 today. Looking at the old floodplain adjacent to Muddy Creek, the down-cutting event mentioned by Sid Weber probably lowered the stream channel by 10 to 12 feet.

Steve Adams also spoke about conditions he remembers as a boy growing up in the 1930s and 1940s. He recalled that in the Sand Gap area, just north of Peach Orchard Flats, a person could tell the number of sheep herds in the area by the number of dust clouds you could see from this high point of ground. Few water developments existed, so the herds had to water at Muddy Creek, then trail miles away to find forage before returning to water at Muddy Creek again.

5) Synthesis and Interpretation:

Existing management and changes in management along with range improvements, at least indirectly, should relate to improved resource conditions. Historic sheep use in this area generally took place in the spring and fall, between summer use on the MBNF and winter use in the desert. Use on the forest had set on and off times, and use in the desert was dependent on winter snow for water. So both spring and fall use occurred for several months each along the creeks with reliable water, resulting in high intensity and long durations of use. The sheep trail at Dad also extended downstream along Muddy Creek to Jerry's corner on the freight line, before dispersing up the various side drainages. Plant cover and species composition, as well as soil compaction, were negatively affected by this impact, with site recovery still occurring.

The paragraph above and the section on reference conditions support the conclusion that the Lower Muddy Creek watershed, as a whole, was the most impacted portion of the entire Muddy Creek watershed by historic livestock grazing. This is further substantiated by the fact that one of the earliest watershed improvement plans developed was in the early 1950s for Muddy Creek, and the area in most need of help was from South Barrel Springs Draw down to Cottonwood Creek on the east side of the Flat Tops. In the 1950s and 1960s, several large watershed projects were completed. These include 25 large retention dams and additional small reservoirs, 2,800 acres of contour furrowing and 1,500 acres of upland spreader-diking (all seeded), 2,000 acres of sagebrush control, cactus control projects, and allotment fencing (picture 20-1). These projects helped to slow water runoff and promote vegetative cover to reduce soil erosion. They are still largely intact and received some maintenance attention in the 1990s, but more attention is still needed. Lee Jons, a current permittee, who has grazed livestock in this area since the 1950s, tried to give a perspective about the vegetative conditions prior to these improvements. He stated that the ground cover was so poor that a man could not jump from one plant to the next closest plant. Cover is much better now, the contour furrows have filled in with native plants along with the crested wheatgrass (picture 20-2).

Management changes relating to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution. These practices have been occurring over the last 20 to 30 years as sheep permits have been converted to cattle. Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. This may mean rotation between allotments or creating fenced pastures within allotments to control season or duration of use. This type of management has also provided the capability to rest and manage livestock use following prescribed burns. Two examples of this are the Doty Mountain allotment (83,000 acres) and the Deep Gulch allotment (35,000 acres), which were cross-fenced in the mid-1980s and mid-1990s respectively. New water developments are used to improve livestock distribution and to create more reliable water sources in order to get through periods of drought. To accomplish this, there has been more emphasis on wells, pipelines, seep developments, and larger reservoirs over the last ten years. Oil and gas field development has created some artesian wells, which have become important water sources for livestock and wildlife.

Wildlfire suppression has created negative impacts to both fire-stimulated species such as aspen and chokecherry and fire-sensitive species such as big sagebrush. Aspen are a fast growing species and provide the largest and most durable building material for beaver dams. The relationship between beaver and aspen is critical to maintaining riparian systems in terms of stream flows and stability due to large woody debris. Aspen habitat is greatly reduced today, and that is largely due to lack of fire in this ecosystem (picture 20-3). Every stream drainage has evidence of old beaver dams, with aspen logs laying on the ground, but little or no regeneration, and shrub dominance by big sagebrush and serviceberry. People who grew up in this area during the early 1900s recall shaking chokecherries into their buckboards to make jams and syrup with. In many areas the chokecherries are gone or in low abundance and vigor. Fire-sensitive species like big sagebrush have become decadent with higher canopy cover. This results in lower species diversity and lower herbaceous cover and production. This in turn creates more surface runoff and soil erosion. Prescribed burns over the past 15 years have been conducted on approximately 10,000 acres in this watershed, with about 4,000 acres affected by wildfires. These have improved ground cover, species and cover diversity, healed small gullies and roads, and improved stream flows. However, much more is needed.

As roads are upgraded and improved, problems associated with them are generally reduced. Main roads have begun to be graveled to reduce long-term maintenance (picture 20-4). Simple practices such as wing-ditching have generally become the standard operating procedure. Water flows are flared out into the vegetation where it benefits plant growth and infiltrates the soil instead of running down the middle or side of the road until it reaches a stream. Greater use of culverts prevents water from running along the road and creating gullies. There is still a need for further work on nearly all improved roads to reach an adequate level of these types of practices to minimize or eliminate overland flow alterations and erosion caused by roads (picture 20-5).

There is a lower standard observed in reclamation efforts around operating wellheads, compared to what can be done as evidenced by BP America, to reduce bare ground that is exposed to wind and water erosion.

Other oil and gas companies involved in the same type of work and resource impacts have not reached the same level in their reclamation (picture 21-1). Reclamation of pipelines is generally good.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing condition of stream channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the cooperation of livestock permittees in implementing best management practices, it is determined that the majority of the Lower Muddy Creek watershed is meeting Standard #1. The few locations that do not meet Standard #1 contain large, active head-cuts due to gradient readjustment processes. These areas affect approximately 6,000 acres. Current livestock grazing practices are not contributing to the non-attainment of Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Continue to eliminate or control active head-cuts, along with the necessary livestock management, in order to promote long-term, vegetative stabilization of these sites.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, which minimize the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Expand public education about its role in public land management, particularly regarding impacts from road and off-highway vehicular activities.

Savery Creek

1) Characterization:

Savery Creek is a perennial stream system, with perennial and intermittent tributaries, which headwater on the MBNF or the foothills to the Sierra Madre mountain range (picture 21-2). It flows from north to south, emptying into the Little Snake River at Savery, about 12 miles east of Baggs. Savery Creek is formed by the confluence of the North Fork, East Fork, and Dirtyman Fork of Savery Creek. Major tributaries include Little Savery Creek, Bird Gulch, Big and Little Sandstone Creeks, Loco Creek, and Big Gulch. The entire drainage is in a 12 to 18-inch precipitation zone with well-developed loamy soils. Elevation ranges from 6,500 at the confluence of Savery Creek and the Little Snake River to 7,800 ft at Browns Hill, 8,200 ft at Rendle Rim and Middlewood Hill, to over 10,000 ft in the MBNF.

Wide meadows and active floodplains occur along the main channel of Savery Creek, with smaller and narrower floodplains found along tributary streams, particularly on higher gradient segments on or adjacent to the MBNF (picture 21-3). On the middle and lower portion of Savery Creek, irrigation has been developed to support grass and alfalfa hay production for winter livestock feed. There are some stream segments where incisement has occurred, primarily on the western portion of the watershed, where soils are silt and clay loams and there is little rocky substrate. The majority of the watershed has either a gravel or rocky base which promotes more lateral stream movement with disturbance, rather than down-cutting. Stream channels are generally stable with perennial vegetation cover, including willows and cottonwood. Average annual flow contributed by the Savery Creek watershed is around 89,000 acre-feet. Flows are highest in May and June and lowest during September.

The majority of stream channels in this watershed are a C4 stream type, with C6 and B4 stream types also present. The C4 stream type is found in broad, gentle gradient alluvial valleys, with predominantly gravels and lesser amounts of cobble, sand, and silt/clay (picture 22-1). They are slightly entrenched, meandering, riffle/pool channels with well developed floodplains. These systems are characterized by the presence of point bars and other depositional features. Rates of lateral adjustment are influenced by the presence and condition of riparian vegetation (Rosgen 1996). The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well- developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent. Rates of lateral adjustment are influenced by the presence and condition of riparian condition. Headwater streams on steeper gradients are B4 stream types. This stream type is found in narrow, moderately steep colluvial valleys, with gradients of two to four percent and channel materials composed predominantly of gravel with lesser amounts of boulders, cobble, and sand (picture 22-2). The B4 stream type is considered relatively stable and is not a high sediment supply stream channel (Rosgen 1996).

Principal human uses in this watershed are livestock grazing, hay production, timber production, and recreation. Livestock use is primarily cattle, employing both cow/calf and yearling operations. Seasons of use at lower elevations are spring through fall with snow usually precluding year-round use. Season of use at higher elevations is usually from mid-May or June through September or October. A small amount of sheep use occurs, generally in the spring and fall, with summers spent on the MBNF. Hay production involves ground preparation and fertilization in the spring, summer irrigation, putting up hay in August or September, and feeding during the winter. Timber production occurs primarily on the MBNF and involves firewood, rails and posts, and small lumber products. Recreation is primarily related to hunting, fishing, or using the Continental Divide National Scenic Trail. The highest use period is during the fall hunting season (September through October). Associated with this use is an improved/unimproved road transportation system and off-highway vehicle use. A large dam is currently being constructed by the State of Wyoming on the middle portion of Savery Creek to provide reliable irrigation water and recreational use (boating and fishing).

2) Issues and Key Questions:

1. Livestock Grazing: In addition to the previously mentioned impacts, this area's impacts are primarily to stream channels, which affect bank stability and width/depth ratios, but also include management which either promotes increased shrub dominance or reduces aspen vigor and regeneration .

2. Erosion- (please refer to issues identified for Upper Muddy Creek on page 7)

3. Woody Plant Health- (please refer to issues identified for Upper Muddy Creek on page 9)

3) Current Conditions:

Quantifiable data about current erosion levels and stream flows, as well as condition and trend are not available. However, information is available from photo-points, channel cross-sections, and personal observations show that the trend for watershed values is upward. Specific management implemented along with range improvements and vegetative treatments, at least indirectly, should also relate to improved resource conditions.

Stream channels are narrowing, with banks becoming more stable with perennial, deep-rooted vegetation. As the channels narrow, the active floodplain width expands, including both lateral expansion on gravel-bottomed streams and within incised banks of silt/clay-bottomed streams where the upper slopes continue to widen and become more stable with vegetative cover. In-channel bank sloughing on outer corners and gradient adjustment of ephemeral side drainages are the primary sources of erosion. The county road in McCarty Canyon, where it follows Little Savery Creek, is also contributing sediment into the stream system. Hydrologic function is improving due to the above-mentioned changes in stream channels and floodplains. However, the general lack of beaver ponds in this system results in faster movement of flow events and reduced water storage for late-season stream flow.

Vegetative cover and litter on uplands are generally very good except on steep south-facing canyon walls, due to precipitation levels and good soils. In the headwaters area, cover and litter range from 70 to 80 percent in big sagebrush communities to over 90 percent in aspen and serviceberry communities. At lower elevations, cover and litter in sagebrush communities may range down to 50 to 60 percent, with lower amounts occurring on drier, south-facing slopes; shallow, rocky soils; and where shrub densities and grazing impacts have reduced understory herbaceous cover.

Like Upper Muddy Creek, the primary natural type of disturbance occurring in this watershed is beaver activity. The concerns and identified habitat issues are the same as stated previously.

4) Reference Conditions:

The earliest (1844) documented conditions of the Savery Creek watershed come from John C. Fremont, an army topographer. The following account comes from the publication, “The Wyoming Landscape, 1805 – 1878.” Upon heading north up the Savery Creek drainage from the Little Snake River, the expidition turned more northward across the hills “where every hollow had a spring of running water, with good grass.” They shortly began seeing buffalo. On “St. Vrain’s fork” (Savery Creek) they killed some bighorn sheep and buffalo. The creek was only wooded with willow thickets. There were aspen groves on the hills above. A band of elk was chased from one of these groves. Antelope were running over the hills and herds of buffalo could be seen on the opposite river plains. They also shot some deer. “The country here appeared more variously stocked with game than any part of the Rocky Mountains we had visited; and its abundance is owing to the excellent pasturage, and its dangerous character as a war ground.”

5) Synthesis and Interpretation:

From the above historical accounts, it appears that the Savery Creek watershed is much the same today, with good water sources, forage, and a mixture of vegetation, which support wildlife and human uses. What has altered the watershed over the last 150 years? The answer is livestock grazing, as well as irrigation, removal of willows and trapping out beaver (which in some cases were promoted by government agencies and policies), and the public perception via Smokey Bear that fire and fire effects are all bad. Motorized vehicles and roads to access the country has also helped change the landscape around us. All of these factors influence resource conditions and all can be manipulated to achieve desired results.

Like the areas discussed earlier, impacts from historic and current livestock use, wildfire suppression, and road problems and off-highway vehicle use has also contributed to degradation of the watershed.

Best management practices for livestock grazing that have been implemented in this watershed include: pasture grazing systems to control duration of use, deferment of riparian pastures to late summer or fall use when possible, development of upland water sources to reduce dependence on streams as water sources, and prescribed burns on uplands to reduce dense brush and increase forage production, availability, and palatability. These changes in management and range improvements, implemented over the last 10 years, have resulted in the following improvement in resource conditions. Surface stream width (at base flows) have been reduced by 50 percent or more in many locations. Graph #4 and pictures 23-1 and 23-2 show change in stream channel morphology from Loco Creek. The figure and pictures both show reduced width/depth of the channel, interior bank building and stabilization with perennial riparian vegetation, and flows at both locations are at higher levels during late-season low flow periods than they were previously. Vegetative bank cover has increased significantly, starting at 25 percent or less and currently exceeding 90 percent. These sites have stabilized with vegetation and, therefore, reduced the unprotected bank area vulnerable to in-channel erosion. This is supported by observations of turbidity, which is only seen now during high runoff and after storm events compared to being commonly observed on a year-round basis prior to management changes. The bank building and expansion of riparian habitat (due to narrowing of stream channels), in addition to vegetative treatments, have led to increased late season flows in all perennial streams.

As roads are upgraded and improved, problems associated with them are generally reduced. Main roads have been graveled or a harder surface developed to reduce long-term maintenance. Simple practices such as wing-ditching have become the standard operating procedure. Water flows are flared out into the vegetation where it benefits plant growth and infiltrates the soil instead of running down the middle or side of the road until it reaches a stream. Greater use of culverts prevents water from running along the road and creating gullies. Improved or closed off stream crossings have reduced vehicular disturbance to channels and banks. There is still a need for further work on nearly all improved roads to reach an adequate level of these types of practices to minimize or eliminate overland flow alterations and erosion caused by roads. The county road in McCarty Canyon where it follows Little Savery Creek is a major problem, which needs immediate attention.

6) Recommendations:

Due to the existing diversity and amount of vegetative cover on uplands, the existing and improving trend in stream vegetation and channel morphology, the cooperation exhibited in livestock management by permittees, and the generally small number of management issues still remaining to be dealt with, it is determined that the Savery Creek watershed is meeting Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Identify and correct problems with improved roads, which affect water flows and soil erosion, in particular the county road along Little Savery Creek. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed (pictures 24-1, 24-2).

Continue to implement vegetation treatments to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion, and promote reliable, late-season stream flows.

Expand public education about its role in public land management, particularly regarding impacts from road and off-highway vehicular activities.

Little Snake River – Willow Creek and Powder Wash segments

1) Characterization:

These two fifth order watersheds follow the main stem of the Little Snake River, and except for Willow Creek, which is primarily located in Colorado, the tributaries and side-drainages are small and ephemeral in nature. Other named side drainages include Rye Grass, McCargar, and Coal Bank Draws above Savery; Dutch Joe Creek, Cottonwood Creek, and Burbank Draw near Dixon; and Garrish, Poison, and Cherokee Draws below Baggs (picture 24-3). The entire area is in a 10 to 14-inch precipitation zone with predominantly shale and clay-loam soils, which can produce high runoff with medium to severe erosion potential. Topography is flat to gently rolling landscape along the valley floor and adjacent foothills and plateaus, becoming moderately steep to steep close to rims, badlands, and higher elevations (picture 24-4).

Elevations along the Little Snake River vary from around 6,000 ft at the lower Colorado state line to 6,600 ft at the upper Colorado state line. Higher points of elevation include: Powder Rim at 7,600 ft, the Bluffs above Baggs at 6,900 ft, Muddy Mountain at 7,900 ft, Horse Mountain at 8,000 ft, and Battle Mountain in the MBNF at just over 9,000 ft.

Channel formation is well-defined along the Little Snake River and perennial sections of a few side drainages and poorly-developed for most side draws. The principal floodplain is along the river, which is primarily influenced by human activities to stabilize it and maintain irrigation capabilities. Side draws often cut through steeper terrain, forming narrow, deep gullies. Some of these are well-vegetated and some are not. Soil cover is naturally low on many slopes, particularly downstream from Baggs. However, grazing by livestock and browsing by big game have also contributed to poorer vegetative cover on erosion-prone soils in specific locations. Erosion sources include in-channel bank sloughing, gullies and side-draw gradient adjustment, and uplands. Flows in these watersheds derive from winter snow or summer and fall thunderstorms. Peak flows usually occur in March or April below Baggs and in April or May higher up in the watershed. These flows contribute small amounts to the Little Snake River prior to the highest flows, which originate from snowpack in the MBNF. Average annual flow contributed by the entire Little Snake River watershed (recorded at the lower Colorado state line) is around 449,000 acre-feet, with May and June being the peak flow months and September being the lowest flow month. The small drainages and draws are not large enough to have been individually gauged for stream flow.

The only site with stream flow in Wyoming where channel classification was determined is the Little Snake River, which is a C6 stream type. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent. Rates of lateral adjustment are influenced by the presence and condition of riparian condition.

Principal human uses in this watershed are livestock grazing, grass and alfalfa hay production, oil and gas development, and recreation. Livestock use is primarily cattle, employing both cow/calf and yearling operations. Sheep use still occurs on a few allotments. Seasons of use for livestock vary by allotment. Winter use is somewhat dependent on annual climate conditions. Hay production involves ground preparation and fertilization in the spring, summer irrigation, putting up hay in August or September, and feeding during the winter. Oil and gas development has occurred in the area for many years. However, it has expanded in scope of area as well as in-field drilling over the last 10 years. There is currently exploratory development for coalbed methane in the area north of Baggs and Dixon. Recreation is mainly related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Erosion: - (please refer to issues identified for Upper Muddy Creek on page 7)

2. Livestock Grazing: Livestock grazing, both historic and current, is the other major factor affecting watershed values in the Little Snake River watershed. Grazing has occurred here since the valley was settled in the 1870s. Sites adjacent to the river and homesteads were probably used for long periods of time each year, just out of convenience. Although these areas were probably overused, which led to lower vegetative cover and more bare ground, they are generally in the middle for condition. Current management issues relate to the season, duration, and distribution of use rather than stocking rates. These issues are primarily directed at impacts to plant cover and litter values compared to percent bare ground. The key question is what refinement in best management practices for livestock grazing or other actions need to be taken to improve watershed health and meet desired resource conditions.

3. Oil and Gas- (please refer to issues identified for Upper Muddy Creek on page 8)

4. Woody Plant Health- (please refer to issues identified for Upper Muddy Creek on page 9)

3) Current Conditions:

Available stream flow information was presented under watershed characteristics. Flows across public lands are primarily from ephemeral drainages, which produce short, flashy events from quickly-melting snow or thunderstorms. Silt/clay soils with low infiltration rates and low vegetative cover help to compound these types of flow events.

Stream channels are well vegetated in the few areas with yearlong or long-term water flow. Most channels are ephemeral and are moderately-vegetated with rhizomatous wheatgrass, basin wildrye, big sagebrush, and other upland species. Active gullies often have some shrubs and grasses, but are generally less well-vegetated. Larger channels tend to have rounded banks with wide floodplains in gentle topography, with steeper banks and confined floodplains where gradients are higher. Most erosion occurs from confined, in-channel sites and from rill and gully erosion from uplands. While much of this is considered background or natural erosion, roads and past grazing practices still have a large effect on contributing to erosion in this watershed.

Vegetative cover and litter on uplands vary with the soils, slope, aspect, elevation, and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover of 30 percent, while sediment yield increased dramatically when cover declined to less than 30 percent (Linse, Smith and Trlica, 1992). Ground cover ranges from 50 to 75 percent on big sagebrush and mountain shrub plant communities to 35 to 50 percent on shale/saltbush steppe and juniper woodland plant communities. Erosion is more prone on the sites with lower vegetative cover and steeper slopes.

4) Reference Conditions:

One of the earliest references to the Little Snake River valley was from John C. Fremont in 1844. On the “Elk Head” (Little Snake) River in the Baggs area, he noted that the river “is a considerable stream, fifty to a hundred yards in width, handsomely and continuously wooded with groves of the narrow-leaved cottonwood, with these were thickets of willow and buffaloberry. The characteristic plant along the river is greasewood, which generally covers the bottoms; mingled with this, are saline shrubs and sagebrush . . . . The country on either side was sandy and poor, scantily wooded with cedars [juniper], but the river bottoms afforded good pasture.” In 1873, W. A. Richards wrote about the country west of Baggs, “Camped on [a] dry creek [Cherokee Draw] . . . . The country here perfectly worthless. Nothing but sagebrush and greasewood. Soil sandy clay.”

5) Synthesis and Interpretation:

The account described above is similar to what could be observed today in terms of landscape and vegetation for the uplands. The principal changes are the irrigation, roads, gas wells, and fences relating to the existing land uses. Although sagebrush and greasewood still occur in the Little Snake River floodplain, they have largely been replaced with irrigated pastures. Cottonwoods, willows, and buffaloberry are still common. The river channel is narrower, due to water diversions, bank stabilization, and return flow irrigation. Adjacent hillsides do not appear to have changed much, with patches of juniper intermixed with sagebrush and grasses, looking good in wet years and poorer in dry years. Roads are the most visible blemish on the landscape, with developed, graded roads most apparent and winding two-tracks less obvious.

Roads and off-highway vehicle use continue to expand. There is still a large need for further work on nearly all improved roads to reach an adequate level of improvement practices (gravelling, additional culverts, wing-ditching, water-bars) to minimize or eliminate overland flow alterations and erosion caused by roads (picture 26-1). This issue is getting larger rather than smaller, with the creation of more roads associated with further development of oil and gas resources. Recreational use of roads is also increasing, and more troublesome, the off-highway activities associated with hunting, joy-riding, and more recently, antler collecting. Greater availability of four-wheel drive pickups, motorcycles, and three/four wheelers have exacerbated this problem, particularly in areas with easy access and proximity to towns and rural habitations.

Management changes that relate to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution (picture 27-1). These practices have been occurring over the last 50 years as sheep permits have been converted to cattle. Historic sheep use in this area generally took place either year-round with small farm flocks or in the spring and fall with larger range flocks. Cattle and sheep use occurs on the bottoms during the winter, and on adjacent uplands when irrigated pastures are being worked, irrigated, and hayed. This promotes use during most or all of the growing season, reducing vegetative vigor and cover and promoting increaser species like wheatgrass and shrubs. Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. New water developments are used to improve livestock distribution and to create more reliable water sources, in order to get through periods of drought.

6) Recommendations:

Although the existing condition and vegetative cover on uplands could be improved, it is adequate for watershed function. Considering that the number of management issues still needing to be addressed are limited, the existing condition of primarily ephemeral channels, and the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, it is determined that the Little Snake River watershed is meeting Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, thus minimizing the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Expand public education about its role in public land management, particularly relating to impacts from road and off-highway vehicular activities.

Sand Creek – Upper and Lower segments

1) Characterization:

Sand Creek is a large ephemeral watershed, which contains numerous drainages and draws, that empties into the Little Snake River about 10 miles west of Baggs, Wyoming. In addition to Sand Creek, other drainages include Willow Creek, Skull Creek, Red Creek, Hangout Wash, Hartt Cabin Draw, Reader Cabin Draw, and Haystack Wash. The majority of the area is in a 7 to 9-inch precipitation zone, rising to a 10 to 12-inch precipitation zone along Powder Rim and the Flat Tops (picture 27-2). Soils are predominantly shale and clay-loam soils, which can produce high runoff with medium to severe erosion potential. Sandy soils and small sand dunes occur in some areas. Topography is flat to gently-rolling landscape for the most part, becoming moderately steep to steep close to rims and badlands (picture 27-3). Elevation ranges from 6,100 at the confluence of Sand Creek and the Little Snake River to 7,100 ft at Adobe Town Rim on the west side, 7,400 to 7,800 ft at the Flat Tops on the east side, and 7,600 ft at the Haystacks on the north border and at Powder Rim on the south border.

Due to low topographic relief and infrequent flow events, channel formation varies widely. In the gentler terrain, floodplains are wide with channels hardly recognizable as slight depressions. Where slopes are higher, wide floodplains may still exist but with channels cut several feet in width and depth. The floodplains of Sand Creek and Willow Creek are wide and shallow, due to both low gradient and sandy banks (picture 28-1). In some locations the channels and floodplains are confined within incised high banks. Erosion sources include both uplands and in-channel. Flows in this watershed derive from winter snow or summer and fall thunderstorms. Peak flows usually occur in February or March when temperatures rise and snow melts across the whole watershed in a short period of time. Average annual flow contributed by the entire Sand Creek watershed is not monitored. However, since it contributes the largest drainage area below Muddy Creek into the Little Snake River, a majority of the 18,000 acre-feet of annual stream flow recorded below Muddy Creek is from the Sand Creek watershed.

The only site where channel classification was determined was the main stems of Sand Creek and Willow Creek, which are both D5 stream types. The D5 stream type is described as a braided stream, found within broad alluvial valleys, with predominantly sand channel bed material, interspersed with silts and clays (picture 28-2). The braided system consists of interconnected distributary channels formed in depositional environments. Channel gradients are generally less than 2% with very high width/depth ratios of 40 to 50 up to 400 or larger. The braided channel system is characterized by high bank erosion rates, excessive deposition occurring as both longitudinal and transverse bars, and annual shifts of the bed location (Rosgen 1996).

Principal human uses in this watershed are natural gas development, livestock grazing, and recreation. There is also a large wild horse herd. Natural gas development has occurred in the area for many years. However, it has slowly expanded into this watershed over the last 30 years, with increasing development over the last 10 years (picture 28-3). Livestock use is primarily cattle and sheep, employing cow/calf and herded range sheep operations. Seasons of use for livestock vary by allotment, but can be made at any time of the year. Winter use is somewhat dependent on annually climate conditions. Recreation is mainly related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Erosion- (please refer to issues identified for Upper Muddy Creek on page 7)

2. Oil and Gas- (please refer to issues identified for Upper Muddy Creek on page 8)

3. Wild Horses: Wild horse populations are 2.5 times the Appropriate Management Level (AML). In a low precipitation desert watershed, with some drought years, when livestock operators are asked to do what's best for the land and reduce livestock use, why does the BLM continue to shirk its responsibility to achieve AML? In this area, use by wild horses is now three times the actual use made by livestock (36,000 AUMs to wild horses and 12,000 AUMs to livestock in 2001). How can monitoring be used to determine a proper population level if wild horse populations are not reduced to the AML? Wild horse use becomes concentrated around a small number of reliable water sources in dry years and the horses move out of the HMA into allotments with developed water for livestock. Why isn't adequate funding provided to develop adequate water for wild horses, manage and resolve distribution of use problems, and properly monitor and resolve impacts to watershed and other resources caused by wild horses?(picture 28-4).

4. Livestock Grazing: Livestock grazing is also a factor affecting watershed values in the Sand Creek watershed. Management issues relate to the season, duration, and distribution of use rather than stocking rates. These issues are primarily directed at impacts to plant cover and litter values compared to percent bare ground. The mixtures of seasons, types of livestock, and generally low actual use have tended to make this a smaller management issue in specific locations. Due to dry conditions and high numbers of wild horses, livestock operators have voluntarily reduced their use levels by half. About one-third of this use is made by winter sheep, which have a low diet overlap and compete less with wild horses than cattle. The key question is what further refinement in best management practices for livestock grazing or other actions need to be taken to improve watershed health and meet desired resource conditions.

5. Woody Plant Health- (please refer to issues identified for Upper Muddy Creek on page 9)

3) Current Conditions:

Available stream flow information was presented under watershed characteristics. Flows across public lands are primarily from ephemeral drainages, which produce short, flashy events from quickly melting snow or thunderstorms. Silt/clay soils with low infiltration rates and low vegetative cover help to compound these types of flow events.

Stream channels are well-vegetated in the few areas with yearlong or long-term water flow. Most channels are ephemeral and are moderately-vegetated with rhizomatous wheatgrass, basin wildrye, big sagebrush, and other upland species. Active gullies often have some shrubs and grasses, but are generally less well vegetated. Larger channels tend to have rounded banks with wide floodplains in gentle topography, with steeper banks and confined floodplains where gradients are higher. Most erosion occurs from confined, in-channel sites and from rill and gully erosion from uplands. While much of this is considered background or natural erosion, roads and past/current grazing practices are large contributors to erosion in this watershed.

Vegetative cover and litter on uplands varies with the soils, slope, aspect, elevation and precipitation. Research conducted in Wyoming indicated that upland plant communities often can be maintained with ground cover of 30 percent, while sediment yield increased dramatically when cover declined to less than 30 percent (Linse, Smith and Trlica, 1992). Ground cover ranges from 50 to 75 percent on big sagebrush plant communities to 35 to 50 percent on saltbush steppe plant communities, the two most common vegetation types in this watershed. Shale flats and badlands fall into the 5 to 30 percent range. These sites do yield some soil erosion, but not as much as one might think. The silts and salts in these soils seem to seal when they get wet, so that most moisture is shed with only small amounts of erosion. This can be observed in reservoir sites, when built close to badlands, they will almost always have water and take a long time to silt in.

4) Reference Conditions:

Due to the remoteness and dry climate of this watershed, there is little historical documentation about rangeland conditions prior to settlement by Euro-Americans. The area was used by several different tribes of nomadic Native Americans on a seasonal basis due to climatic conditions.

5) Synthesis and Interpretation:

The principal changes observed today compared to pre-settlement are the roads, gas wells, and fences that relate to the existing land uses. Roads and off-highway vehicle use continue to expand. There is still a large need for further work on nearly all improved roads to reach an adequate level of improvement practices (gravelling, additional culverts, wing-ditching, water-bars) to minimize or eliminate overland flow alterations and erosion caused by roads (picture 29-1). This issue is getting larger rather than smaller, with the creation of more roads associated with further development of oil and gas resources. Use of seismic testing vehicles in oil and gas exploration is relatively low impact. However, some of these routes evolve into roads through continual use by hunters (picture 29-2). Recreational use of roads is also increasing and more troublesome are the off-highway activities associated with hunting, joy-riding, and more recently, antler collecting. Greater availability of four-wheel drive pickups, motorcycles, and three/four wheelers has exacerbated this problem, particularly in areas with easy access and proximity to towns and rural habitations.

There is a lower standard observed in reclamation efforts around operating wellheads, compared to what can be done as evidenced by BP America, to reduce bare ground that is exposed to wind and water erosion.

Other oil and gas companies involved in the same type of work and resource impacts have not reached the same level in their reclamation. Reclamation of pipelines is generally good.

Management changes relating to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution. These practices have been occurring over the last 50 years as sheep permits have been converted to cattle. Historic sheep use in this area generally took place between late fall and early spring (dormant period of plant growth) when there was adequate snow, since water developments were not present. Too much snow or lack of snow would limit the annual amount of sheep use. This appears to have left plant cover and species composition in good condition. The long-term decline of the sheep industry across this region reduces management options and flexibility. Some allotments will likely never convert to cattle due to terrain, plant species composition, and competition with wild horses. In a study just north of this area, dietary overlap between horses and cattle during the summer averaged 72% and increased to 84% during the winter (Krysl et. al., 1984). Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. New water developments are used to improve livestock distribution and to create more reliable water sources, in order to get through periods of drought. The lack of fencing in much of this area requires a greater control of livestock through herding, which in some cases is not adequate, leading to trespass livestock use on adjoining allotments. Control of livestock is also complicated by mineral development activities, which can involve lack of maintenance on cattle-guards, leaving gates open or fences down, and inadequate construction techniques (picture 30-1).

Horses were brought into this country by the Spanish in the 1500s. Early historical accounts from adjacent watersheds never mention wild horses, but do mention buffalo, antelope, and other big game species. Most wild horses are the result of domestic horses getting away and becoming wild or older horses being turned loose. A market for horses developed during World War I and many current-day livestock producers made their start by capturing and selling wild horses. It was a source of extra money to help get by with, above the living made with livestock. The ranches tried to manage wild horses along with their livestock (in a general sense) according to what the land could support. With the advent of the Wild Horse and Burro Act in 1971, responsibility for managing wild horses was given to the BLM. However, adequate funding for roundups, management, and monitoring has been lacking. The current population of wild horses in Adobe Town is higher than ever, and even without quantifiable data, is damaging vegetative cover and other watershed values.

6) Recommendations:

Due to the existing condition and vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Sand Creek watershed is meeting Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Reduce and maintain wild horse populations in the Adobe Town HMA from the current level of approximately 2,400 wild horses to the AML of 600 to 800 wild horses. Ensure adequate monitoring to determine if this AML is the appropriate level to manage for with regard to watershed values and other multiple uses of public lands. Develop additional water sources and improve distribution of wild horse use away from historic areas of concentrated use due to lack of adequate sources of water.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, in order to minimize the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter and, therefore, minimize surface runoff and soil erosion.

Expand public education about its role in public land management, particularly regarding impacts from road and off-highway vehicular activities.

Shell Creek

1) Characterization:

Shell Creek is a large ephemeral watershed, just to the west of Sand Creek and is a tributary of Vermillion Creek, which empties into the Little Snake River in Colorado. Small, ephemeral side draws contribute seasonal flows into Shell Creek. The majority of the area is in a 7 to 9-inch precipitation zone, rising to a 10 to 12-inch precipitation zone along Powder Rim and Kinney Rim. Soils are predominantly shale and clay-loam soils, which can produce high runoff with medium to severe erosion potential. Sandy soils and small sand dunes occur in some areas. Topography is flat to gently rolling landscape for the most part, becoming moderately steep to steep close to rims and badlands. Elevation ranges from 6,650 at the state line to 7,100 ft at Adobe Town Rim to the north, 7,600 ft at Powder Rim to the east, and 8,000 ft at Kinney Rim on the west border (picture 31-1).

Due to low topographic relief and infrequent flow events, channel formation varies widely. In the gentler terrain, floodplains are wide with channels hardly recognizable as slight depressions. Where slopes are higher, wide floodplains may still exist but with channels cut several feet in width and depth. The main stream channel and floodplain of Shell Creek is well-defined, with lower slopes to uplands in the upper basin and more incised banks and steep slopes in the lower basin. Erosion sources include both uplands and in-channel. Flows in this watershed derive from winter snow or summer and fall thunderstorms. Peak flows usually occur in February or March when temperatures rise and snow melts across the whole watershed in a short period of time. Average annual flow from the portion of Shell Creek watershed in Wyoming is not monitored.

The only site where channel classification was determined was the main stem of Shell Creek, which is a C6 stream type. The C6 stream type is a slightly entrenched, meandering, silt-clay dominated, riffle-pool channel with a well-developed floodplain (Rosgen 1996). It occurs in broad valleys with gentle gradients of less than two percent. Rates of lateral adjustment are influenced by the presence and condition of riparian condition (picture 31-2).

Principal human uses in this watershed are natural gas development, livestock grazing, and recreation. There is also a large wild horse herd. Natural gas development has occurred in the area for many years. However, it has slowly expanded into this watershed over the last 30 years, with increasing development over the last 10 years. Livestock use is cattle and sheep, employing cow/calf and herded range sheep operations. Seasons of use for livestock will vary by allotment, but can be made at any time of the year. Winter use is somewhat dependent on annual climate conditions. Recreation is mainly related to hunting, primarily during the fall (September through October).

2) Issues and Key Questions:

1. Erosion- (please refer to issues identified for Upper Muddy Creek on page 7)

2. Oil and Gas- (please refer to issues identified for Upper Muddy Creek on page 8)

3. Wild Horses- (please refer to issues identified for Sand Creek on page 27)

4. Livestock Grazing- (please refer to issues identified for Sand Creek on page 27)

5. Woody Plant Health- (please refer to issues identified for Upper Muddy Creek on page 9)

3) Current Conditions:

Available stream flow information was presented under watershed characteristics. Flows across public lands are primarily from ephemeral drainages, which produce short, flashy events from quickly melting snow or thunderstorms. Silt/clay soils with low infiltration rates and low vegetative cover help to compound these types of flow events.

Stream channels are well vegetated in the few areas with yearlong or long-term water flow as stated in the earlier Sand Creek discussion earlier. Vegetative cover and litter also is similar to Sand Creek and will not be repeated here.

4) Reference Conditions:

Due to the remoteness and dry climate of this watershed, there is little historical documentation about conditions prior to settlement by Euro-Americans. The area was used by several different tribes of Native Americans in a nomadic and seasonal manner due to climatic conditions.

5) Synthesis and Interpretation:

As discussed in the Sand Creek section, the principal changes observed today compared to pre-settlement are the roads, gas wells, and fences that relate to the existing land uses. Road-related factors (both commercial and recreational) and well reclamation efforts are the important issues to address.

Management changes that relate to livestock grazing include: pasture grazing systems to manipulate duration and season of use to provide some growing season rest in each pasture and development of upland water sources to improve livestock distribution. These practices have been occurring over the last 50 years as sheep permits were converted to cattle. Historic sheep use in this area generally took place between late fall and early spring (dormant period of plant growth) when there was adequate snow, since water developments were not present. Too much snow or lack of snow would limit the annual amount of sheep use. This appears to have left plant cover and species composition in good condition. Current management systems are being modified where needed to improve plant vigor and vegetative cover by ensuring at least partial rest during the growing season. New water developments are used to improve livestock distribution and to create more reliable water sources, in order to get through periods of drought. The lack of fencing in much of this area requires a greater control of livestock through herding, which in some cases is not adequate, leading to trespass livestock use on adjoining allotments.

Wild horses in this assessment area have the same impacts as those previously described in the Sand Creek section.

6) Recommendations:

Due to the existing condition and vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Shell Creek watershed is meeting

Standard #1. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Reduce and maintain wild horse populations in the Adobe Town HMA from the current level of approximately 2,000 wild horses to the AML of 600 to 800 wild horses. Ensure adequate monitoring to determine if this AML is the appropriate level to manage for with regard to watershed values and other multiple uses of public lands. Develop additional water sources and improve distribution of wild horse use away from historic areas of concentrated use due to lack of adequate sources of water.

Identify and correct problems with improved roads, which affect water flows and soil erosion. Two-track roads are too numerous to deal with as a whole, however, problem areas should identified and fixed or the road should be closed and reclaimed. All oil and gas companies should implement reclamation practices on active and dry hole locations, in order to minimize the amount of bare ground exposed to wind and water erosion.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Specific dates or times must be decided on a case-by-case basis. Methods to achieve this include, but are not limited to, herding, pasture fencing, water developments, and vegetation treatments.

Implement vegetation treatments where needed to restore plant communities with diverse species, age classes, and cover types. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Expand public education about its role in public land management, particularly regarding impacts from road and off-highway vehicular activities.

STANDARD 2-RIPARIAN/WETLAND HEALTH

Riparian and wetland vegetation have structural, age, and species diversity characteristic of the state of channel success and is resilient and capable of recovering from natural and human disturbance in order to provide forage and cover, capture sediment, dissipate energy, and provide for ground water recharge.

Riparian/wetland habitat makes up less than one percent of the Upper Colorado River Basin. Although this is a very small percentage of the basin, these areas are some of the most productive found on public lands. They are important for recreation, fish and wildlife habitat, water supply, cultural and historic values, as well as livestock production. The basin consists of a variety of riparian/wetland types ranging from perennial systems to intermittent in the higher country to ephemeral-dominated in the lower desert country.

1) Characterization:

The most common systems in the upper watershed are classified as riparian grassland and willow-waterbirch riparian shrublands. Less common systems include aspen and cottonwood riparian woodlands. Riparian grasslands are wetland, stream, or spring-associated grass and grass-like communities, which are maintained by water tables within root depth during most of the growing season (picture 34-1). These sites occur in lowland positions, generally at 5,850 to 8,400 ft. Dominant species include Nebraska and beaked sedges, Baltic rush, tufted hairgrass, basin wildrye, northern and canary reedgrass, Kentucky bluegrass, Nuttull's alkaligrass, and redtop. The shrub layer is sparse but willow and waterbirch may occur. Examples within the assessment area include: upper portions of Littlefield Creek, McKinney Creek and Little Savery Creek, and the headwaters of Deep Gulch, Wild Cow, and Cherokee Creeks.

The willow-waterbirch dominated riparian shrublands generally occur at 6,300 to 8,400 ft in locations which are too cool for cottonwood stands and too wet for aspen woodlands (34-2). The most common willow species in the watershed consist of Geyer, Booth, sandbar, and yellow willows. Additional shrubs are hawthorn, dogwood, currant, snowberry, rose, and individual quaking aspen. The herbaceous understory generally includes Nebraska sedge, beaked sedge, tufted hairgrass, Kentucky bluegrass and redtop. Several creeks support this type of community including; Littlefield Creek, Muddy Creek, Little Savery Creek, McCarty Creek, Bird Gulch, McKinney Creek, Dirtyman Creek, Morgan Creek, Truck Driver's Creek, and Savery Creek.

Aspen riparian woodlands have largely been eliminated in the watershed but consist of riparian areas dominated by quaking aspen. These sites occur on gentle "cool" (shaded or high elevation) slopes near springs or ponds, typically at 6,000 to 8,100 ft. Soils are poorly-drained and water tables are within root depth during most of the growing season. Overstory species are aspen, willow, and limber pine. The shrub layer is more open than either willow-waterbirch or cottonwood riparian sites and is dominated by common juniper and big sagebrush. Other species associated with this habitat type are shrubby cinquefoil, tufted hairgrass, letterman's needlegrass, wheatgrasses, bluegrasses, reedgrasses, sedges, and rushes in the herbaceous layer.

Cottonwood riparian woodlands are dominated by narrowleaf cottonwood, along with quaking aspen and box elder and are frequently intermingled with willow and riparian grasslands (picture 34-3). They occur on gentle, "warm" (sunny, lower elevation) slopes at 5,850 to 7,300 ft where water tables are within root depth during most of the growing season. The shrub understory is dominated by willows, currant, big sagebrush and rose; while the herbaceous cover is commonly basin wildrye, needle-and-thread grass, wheatgrasses, rushes, barley, and dock. Examples of this type of riparian community within the area include: Cottonwood Creek, Little Snake River, Loco Creek, Savery Creek, and Little Sandstone Creek.

Aquatic vegetation common in flowing systems in the watershed include brookgrass and eliocharis along the water's edge where areas are stabilizing (picture 34-4). These two species are colonizers and greatly accelerate stream channel narrowing and bank development. Pondweed and chara are the most common species found within the channels.

The remaining portion of the basin consists of ephemeral drainages, which flow only during spring runoff or in conjunction with intense thunderstorms. These areas do not meet the riparian standard in that they do not support wetland vegetation nor do they have hydric soils. Hydric soils are formed when there are long periods of water saturation, which produces anaerobic conditions within the soil (picture 35-1).

Wetland systems within the watershed include playa lakes, manmade reservoirs, seeps, springs, and wetlands, including the George Dew and Red Wash wetlands (pictures 35-2, 35-3). Large wetland systems support open aquatic-emergent wetland habitat (picture 35-4). They range from open expanses of deep water to shallow water bodies, that are choked with emergent vegetation. Dominant plants are Nebraska and beaked sedges, northern and canary reedgrasses, tufted hairgrass, cattail, rushes, Garrison foxtail, Baltic rush, bulrushes, potentilla, aster, mint and docks. In some cases there is a shrub layer dominated by inundated willow or waterbirch thickets.

Manmade reservoirs provide additional wetland habitat throughout the basin (picture 35-5). In the higher elevations, these systems are primarily herbaceous or willow riparian systems. In the lower elevations, wetland habitat along small reservoirs provide important habitat diversity in desert dominated upland vegetation communities. Reservoirs having more perennial water sources may support herbaceous riparian vegetation, while others may support woody species such as willows and even cottonwoods. Several of these reservoirs have been totally or partially fenced to protect their important habitat qualities. Those areas that have not yet been fenced in the lower elevations tend to have limited riparian vegetation due to yearlong wild horse and livestock use (pictures 35-6 thru 35-8). The majority of manmade reservoirs within the watershed tend to be ephemeral and do not support wetland qualities.

Seeps and springs are common throughout the area. These springs and seeps are discharged groundwater via fractures in underling rock or fault lines (Tiner et al., 2002). In the higher elevations, many of these springs provide the headwater sources and recharge perennial streams. In the lower elevations, many of these important water sources support a limited area and do not flow as a perennial lotic system. Many of these wet areas support or are capable of supporting riparian vegetation and wetland habitat of variable sizes.

The last type of wetland habitat found in this area are playa lake beds. During drier climatic cycles these depressional areas may lack hydrology and/or hydrophytic vegetation indicators that would identify them as wetlands. During wet years, they provide a productive and diverse composition, but during dry years the site may be dominated by upland species, particularly rhizomatous wheatgrass and annual forbs. Playas obtain water primarily from rainfall and local runoff and naturally go through several wet/dry periods over the years. However, given their capability and potential, most of these systems in the analysis area are in good health.

<u>Evaluation Method:</u>
The primary method used in evaluating this standard is through a qualitative assessment procedure called Proper Functioning Condition (PFC). This process evaluates physical functioning of riparian/wetland areas through consideration of hydrology, vegetation, and soil/landform attributes. A properly functioning riparian /wetland area will provide the elements contained in the definition(need to add wetland indicators)

- Dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality
- Filter sediment, capture bedload and aid floodplain development
- Improve flood-water retention and ground water recharge
- Develop root masses that stabilize streambanks against cutting action (TR 1737-15 1998)

It is important to note that the PFC assessment provides information on whether an area is physically functioning in a manner that allows maintenance or recovery of desired values (e.g., fish habitat, neotropical birds, or forage) over time. PFC is not desired or future condition (TR 1737-15 1998). PFC assessments are used along with other existing information such as stream cross-sections, photopoints, and habitat assessments to evaluate this standard of rangeland health.

Within the watershed 63% were determined to be PFC, 36% were determined to be Functioning-At-Risk, and 1% were determined to be Non-functioning (see Map #6). In the upper watershed, several assessments of the same area have been completed, including a test case of the aerial photography method for assessing PFC, which was done by the National Science and Technology Center (NSTC). The findings of the NSTC group correlated with the ratings of the most recent PFC evaluations done on-site. Most of the area is either functioning properly or is functioning-at-risk with an upward trend, and therefore, moving towards the minimum standard. Specific areas that are not meeting this standard will be discussed individually.

2) Issues and Key Questions:

Livestock, wild horses, and wildlife grazing along riparian areas has been and continues to be an important factor relating to riparian health within the basin. Historic livestock grazing use that included trailing large numbers of livestock, much longer durations of use, herbicide spraying of riparian communities, trapping beaver out of the system, and the practice of using riparian zones as sacrifice areas contributed to the decline in riparian conditions. Current livestock and wildlife grazing use may be negatively impacting establishment and/or production of woody riparian plant species such as willows, dogwood, waterbirch or cottonwood in some portions of the watershed. In areas where wild horses are present, year round grazing use on riparian areas by horses and cumulatively by livestock and wildlife have negatively impacted riparian vegetation. The physical presence of grazing animals, whether domesticated or not, has a direct impact on riparian vegetation, and in some cases (depending on soil type) has resulted in hummocked riparian areas. If the area is hummocked, the riparian system may lose its ability to function and can essentially dewater a seep or spring. If livestock use has been addressed, how will damaged riparian areas be improved without exclusion of wild horses and/or wildlife?

Movement of animals through riparian areas can affect functionality by increasing bare ground, usually observed in the form of trails and crossings (pictures 36-1, 36-2). Higher numbers or an increased duration of use will create a greater impact and consequently more bare ground. Increased bare ground reduces the ability of the system to function properly in high flow events. In many cases, best management practices have been implemented which reduce the duration and/or change the season of grazing use for livestock. For example, reducing duration of use and developing upland water has resulted in trails re-vegetating. Continued refinement of these practices will address the current livestock grazing use aspect. Is trespass livestock use a part of the problem and if so, is it being addressed? What actions need to be taken to adequately address yearlong wild horse use and/or wildlife use of certain riparian areas?

There are certain areas within the assessment areas where hummock areas occur adjacent to riparian areas. Many of these are a factor of the soil involved and the historic long duration of livestock use that has occurred within the area. Will implementation of best management grazing practices address these areas at risk?

Reduced duration by livestock has greatly improved herbaceous vegetation vigor, composition, and density throughout the watershed. Many of these areas have responded favorably by producing a healthy herbaceous understory capable of maintaining riparian function. However, loss of woody vegetation due to past grazing practices, herbicide applications, lack of naturally occurring wildfire and wildlife use has greatly decreased woody plant communities. Aspen riparian communities are largely absent, and other woody dominated communities such as willow, alder, and water birch are greatly reduced in density and dominance. Unfortunately, in many of these systems, healthy riparian herbaceous vegetation may inhibit woody plant regeneration. Once these systems are dominated by a healthy herbaceous understory, woody plants don’t have the microsites they require for reestablishment. Unless these areas are treated with high concentrations of livestock use to create bare soil or some other disturbance factor such as a high flow event, the woody species may not reclaim their original presence within the system. Disturbance is the natural way for this to occur, such as when beaver dams wash out and during high flow events and bare soil sites are created for seed-initiated species to start new plants and expand their populations. But with few beaver and 15 years since the last high flow event, these processes seldom occurred. Should short duration, concentrated livestock use be prescribed to cause disturbance on banks to create openings for these seed-borne species?

Plantings have been undertaken in the watershed; however, the scale of the area has hindered reestablishment efforts. For the most part, natural reseeding of rushes, sedges, and eleocharus has occurred. However, manual planting of other species has been the only successful way to increase other important species. Plugs of bulrushes and cattails are very successful, and cuttings of willow and other shrubs have varying levels of success. Will continued plantings and site-specific treatments result in desired future condition for many of these priority areas? In addition, will the herbaceous-dominated communities serve the same purpose for riparian objectives or will more intensive effort be needed?

Vertical instability is a problem throughout the watershed due to the fine sediments and, in some areas, naturally-erosive range sites. Several headcuts have been stabilized within the watershed; however, there are still areas that need to be addressed. Manmade structures such as reservoirs, created wetlands, and the extensive system of spreaderdikes northwest of Baggs also have instability problems due to naturally fine sediments. Cutting of the spillways on reservoirs or around or through dikes are ongoing problems affecting functionality. What is practical to address these instability issues?

Another factor affecting riparian health is roads and their associated impacts on these areas. Roads that are directly adjacent to riparian systems in many cases channel sediments directly into creeks and reservoirs. In addition, improperly-placed or improperly-sized culverts can increase erosion directly into riparian systems. If the amount of sediment is high enough, it can reduce vegetation, reduce functionality, decrease water quality, and change the channel dynamics. Roads can also interrupt surface and subsurface flow, which can effectively change the type of riparian system from one side to the other. Can road related concerns be addressed through culverts, rerouting, water bars, and roadside pits or are there additional solutions that can be implemented?

Given the potential for coalbed methane development in the area, will the groundwater that feeds the springs and seeps in the area be affected? While for the most part, water discharged from coalbed methane wells will be re-injected, drawdown and consequent reinjection could affect these important systems.

3) Current Conditions

PFC assessments have been conducted in the watershed since the mid 1990s, with the most recent assessments occurring in 2001. Several places in the upper watershed have been assessed more than once during that time. Extensive documentation of riparian condition including photopoints, greenlines, channel cross-sections, habitat quality assessments, and woody plant studies exist throughout the watershed.

LOTIC SYSTEMS:
Perennial streams in the upper elevations vary from the most common riparian area consisting of sedges and rushes stabilizing the stream channels, with or without a woody plants, to a few rock armored higher gradient channels (pictures 37-1, 37-2). The majority of these riparian areas are rated PFC. Healthy, vigorous sedge and rush communities stabilize the majority of these systems. Before management was implemented, many of these areas were dominated by upland grass species such as Kentucky bluegrass that is adapted to heavier grazing use. Upland forbs and other grass species resistant to grazing consequently increased along stream channels. These species may endure overgrazing but provide very little riparian stability. They have shallow roots that are not capable of stabilizing soils adjacent to riparian areas especially in high flows. With only upland species protecting the streambank, bank sloughing, bare ground, and vertical cutting were common. Platts et al. (1987) states that the highest rating for streambank alteration is when less than 25 percent of the streambank is false, broken down, or eroding. Where best management livestock grazing practices have been implemented, riparian herbaceous communities have responded quickly. As upland plants start moving out, early successional plants such as spike-sedge and creeping potentilla start coming in. Then sedges and rushes begin to dominate the riparian community. Along Little Muddy Creek, recent greenlines documented over 90% riparian vegetative cover, with Kentucky bluegrass largely absent within the wetter zones. Shortening duration of use, frequency of use, and timing of use has resulted in a vigorous, productive and, most importantly, stable forage base. Streambanks are lined with obligate and facultative riparian plants that are capable of holding together the riparian area even in high flows. These plants have deep and extensive root systems that stabilize the

channels and also play an important part in channel roughness during high flows and filtration of sediments. Little to no bare ground, channel sloughing, or instability in these systems is present today.

Although these herbaceous communities provide functionality, in many areas additional components are desired. Some of these systems have a woody component consisting of willow (Geyer, Bebb, Booth, sandbar), waterbirch, golden currant, dogwood, alder, or cottonwood. Current condition of many of these woody shrubs, especially willows, are primarily mature to decadent. Past livestock use has hedged many of the mature willow into mushroom shapes or eliminated them by heavy use or herbicide spraying (picture 38-1). Changes made in management has restored natural growth forms of these woody shrubs (picture 38-2). However, dominance of many of these riparian areas by herbaceous species such as Nebraska and beaked sedge and Baltic rush control the site so well that woody plant establishment has been minimal. Only in areas where there is bare soil has there been any woody regeneration. In this case, upstream implementation of a shorter duration of use and multiple years of rest have resulted in a very healthy Nebraska sedge-dominated riparian type. Downstream, implementation of a grazing system was slower, therefore livestock use and physical impacts were higher. This use resulted in more open areas allowing willow to establish throughout the pasture. It has been shown in the literature that for Bebb willow, high light intensities are necessary for seedling establishment, making dense sedge communities less conducive for willow establishment (Atchley and Marlow, 1989).

There are certain localized areas within the assessment area where wildlife use has also impacted the woody components of some riparian systems. High concentration areas of elk during transitions from summer to winter ranges has shown heavy browsing use on certain willow communities (picture 38-3). This use is increasing largely due to the increased numbers of wildlife, especially elk, over an ever-increasing area.

In most cases throughout the basin, livestock numbers have not been decreased to achieve riparian objectives. Depending on the specific situation, best management practices for livestock grazing have been implemented on a case-by-case basis in the majority of the watershed. In some cases, many practices and improvements needed to be implemented and in others, just a slight adjustment was needed.

In addition to adjusting duration and season of use by livestock in riparian areas, additional water sources have greatly improved riparian areas. Upland water developments such as spring developments, reservoirs, and pipelines reduce the dependence of livestock on riparian habitats and result in better distribution of the animals in a pasture. Specifically, spring developments protect the water source, improve water quality and flow, and provide greater flexibility in grazing rotations (picture 38-4). In some cases, pastures with riparian habitat are deferred to late summer or fall use. Pastures with primarily reservoirs and seeps are used first, saving the more reliable pastures with streams for late-season use. This has worked particularly well during drought.

Vegetation treatments, prescribed burning and herbicide applications, also improve distribution of both livestock and wildlife, while diversifying upland shrub communities and age classes. These treatments also increase water recharge into the overall riparian system resulting in higher and longer duration of flows. In some cases springs may start to flow that hadn't prior to treatment.

Fencing has been used to reduce duration of grazing on riparian habitats within most allotments. For the most part, there are few exclosures within the basin. Managing livestock use across the watershed by strategic placement of fences and other improvements has resulted in decreased grazing duration on riparian communities overall without the need for exclusion, complete rest, or decreasing AUMs.

Beaver are considered hydrologic modifiers in the PFC process (picture 38-5). This means they can directly affect stability of those systems that have a woody component. Beaver are present in the watershed, with more being present in the Savery Creek drainage than Muddy Creek due to habitat requirements (pictures 38-6, 38-7). Loss of willow over time has contributed to the reduction in beaver. Some experiments have tried to manipulate beaver into reclaiming stability and increasing woody species, with varying degrees of success. Large aspen were provided to the beaver, resulting in the stabilization of one site along Littlefield Creek. In areas where there is limited woody plant density, beaver can dramatically reduce the woody component in a short period of time even when aspen is made available.

Intermittent and Ephemeral drainages
In the lower elevations of this watershed, riparian communities consist of mainly intermittent and ephemeral drainages, in addition to playa lake-beds (pictures 39-1, 39-2). These communities vary from riparian herbaceous-dominated to coyote willow- dominated to an absence of riparian vegetation of any kind. In many cases, these systems are higher in alkalinity, and plant communities must be adaptive to that condition). The systems having longer periods of water availability tend to have facultative wetland plants such as Nebraska sedge, bulrushes, and cattails. Most of these systems have historically downcut and are in a state of adjustment as described in the channel evolution discussion in Standard 1. The majority of the drainages in the south and western portion of this basin are ephemeral with little to no riparian vegetation. For instance, Sand Creek, which is classified as a braided channel, has no riparian vegetation for stabilization due to extreme fluctuations in water availability and channel variability.

Lotic areas not meeting PFC that are livestock related:

Cherokee allotment
The riparian areas within the Cherokee allotment are not meeting the minimum standard for riparian health due to season and duration of livestock use. The Cherokee allotment is an incommon use area with nine permittees who run both cattle and sheep. An allotment management plan (AMP) is currently being implemented to address these issues. Pasture development and numerous water developments along with adjustments of the livestock grazing operation will result in controlled season and duration of use and lead to improvements in riparian health. A good example of this can be seen from the bridge across Muddy Creek on the southwest border of the allotment. Muddy Creek in Cherokee allotment reflects season-long cattle use, while the picture looking downstream reflects the change after two years of controlled season and duration of use with both cattle and horses.

Sulphur Springs allotment
Portions of the riparian areas within the Sulphur Springs allotment are not meeting the minimum standard for riparian health due to season and duration of livestock use. This allotment is used by one permittee and is grazed by cattle, with the AMP recently revised to address riparian management concerns. Several range improvements have been developed within this allotment including fencing, water developments, instream structures, and plantings. Numerous photopoints have demonstrated improvements in riparian condition in many areas of the allotment (pictures 39-3, 39-4). However, some of the pasture boundaries within the allotment are topographic and are not effective at controlling livestock distribution and duration. Additional drift-fencing is planned to improve livestock management, in order for riparian systems to continue to heal and reach proper functioning condition.

Standard allotment
A small portion of Savery Creek within the Standard allotment is not meeting the minimum standard for riparian health due to duration and distribution of livestock use. The permittee is planning to construct a cross-fence on private land in order to rotate livestock use. Moving the allotment boundary so this small piece of Savery Creek is in an adjacent allotment, is a second possible option, that would greatly improve riparian condition by using it only for fall cattle use.

Rasmussen Subunit allotment
The lower portion of Bird Gulch was recently assessed and did not meet the minimum riparian standard. The remaining portion was found to be properly functioning. Historical use of the allotment included several permittees with season-long use, which caused the entire area of Bird Gulch to be in poor condition. Currently, there are only two permittees with a shorter season of use and light stocking rates. Most riparian areas have responded favorably to this improvement in management, however, the lower end still has some trespass and duration of use issues. In addition, cross-fencing and prescribed burning would also greatly improve riparian health.

Sage Creek allotment

Fish Creek was assessed in the mid 1990s, and portions were found to be Functioning-At-Risk either with a downward or static trend, and one portion was identified as non-functioning. Since that time, overall riparian condition has improved primarily due to variation in livestock use. Recently, Sage Creek allotment has come under new management, with a grazing plan and objectives, which should lead to more rapid improvement in condition. The majority of this allotment is in the Lower North Platte River watershed, therefore, it will not be assessed for S&Gs until 2004.

Pine Grove allotment
The majority of the riparian areas within the Muddy Creek portion of the allotment were found to be properly functioning. Since an intensive management plan was implemented on this allotment (over five years ago), riparian conditions have greatly improved. Upper McKinney Creek was once on the water impairment list for the state of Wyoming, but has since been delisted. The remaining riparian area that is not meeting the standard is lower McKinney Creek, which is being influenced by shale and heavy clay geologic units. Naturally erosive soils continue to influence the site potential of this particular riparian area. The majority of this allotment is in the Lower North Platte River watershed, therefore, it will not be assessed for S&Gs until 2004.

LENTIC SYSTEMS

George Dew Wetlands

The largest mosaic of wetland habitat within the watershed is the George Dew meadows. This area of Muddy Creek has been influenced by dikes, ditching, and irrigation for nearly 100 years. This floodplain is ½-¾ miles wide and was threatened by severe headcutting and spreader dike failure. These issues were addressed to ensure this habitat would be maintained. A cooperative effort between private landowners, BLM, NRCS, Little Snake River Conservation District (LSRCD), Ducks Unlimited, Snyder Oil, and many others made the improvement possible. The area has greatly expanded in size from 1000 acres to over 1500 acres. The riparian area is in PFC and provides open water and brood-rearing habitat for migrating waterfowl, nesting waterfowl, and other wildlife. This area is primarily a willow riparian habitat type merging into sagebrush/greasewood/grass on adjacent uplands. The drier fringes that flood infrequently are dominated by alkaligrass, meadow foxtail, rhizomatous wheatgrass, and some forbs. The area that is flooded in the spring has a high diversity of plants including: yellow and coyote willow, Nebraska, beaked, and wooly pod sedges, tufted hairgrass, American bulrush, reed canarygrass, Garrison creeping foxtail, Baltic rush, spikesedge, mint, cinquefoil, plantain, arrowgrass, aster, and milkwort. Production varies from one ton per acre in the drier areas, two to four tons per acre in sedge-dominated areas, and six to eight tons per acre in reed canary grass areas. Livestock grazing of the George Dew is carefully balanced to maintain healthy willow communities for beaver and mule deer habitat while closely grazing some grassy areas for spring waterfowl use.

Red Wash Wetlands

This is a relatively new wetland formed by spreader dikes constructed adjacent to Muddy Creek with water controlled through an irrigation ditch. When this project is completed there will be an additional 210-220 wetland acres. Common species found in this riparian wetland habitat include: alkaligrass, tufted hairgrass, sloughgrass, northern reedgrass, wheatgrass, coyote willow, cattail, and various sedges, rushes, bulrushes, and forbs.

Manmade reservoirs/Seeps/Springs

Several manmade reservoirs, both large and small exist throughout the area. Several were built in the 1960s, and many of these support riparian and wetland habitat. Larger reservoirs have been built recently by the LSRCD to fulfill several purposes, including livestock and wildlife water, wetland and riparian habitat, and fishery values. A very large reservoir on Savery Creek is being constructed in the upper watershed that will have multiple values including irrigation water, recreation, and additional Colorado River cutthroat trout habitat.

Lentic areas not meeting PFC that are livestock related:

The following allotments are located west of Hwy 789 and were evaluated in the first two years of the standards and guidelines process. They tend to have very limited riparian vegetation, usually in small areas around springs, seeps, and reservoirs.

In the Powder Mountain allotment, the 1998 S&G evaluation rated Upper Powder Springs as Functional At Risk with an upward trend. Factors identified that were affecting this riparian area were both livestock and wild horse use. In 1999, a spring was developed and fenced.

The Powder Rim allotment was also evaluated in 1998, and two springs (Chimney and Rotten) were determined to be non-functional due to livestock grazing. In addition, Lower Soap Holes was found to be Functioning-At-Risk with a downward trend due to livestock grazing. Since that time, both the Chimney and Rotten Springs have been repaired. Lower Soap Holes is scheduled in the Range Improvement work plan for 2002.

Both the Cow Creek and Espitalier allotments were evaluated for S&Gs in 1999, and the team found that the Kinney Rim Seep Complex was Functioning-At-Risk with a downward trend due to livestock and wild horse use. This seep complex is scheduled for initial development in 2002.

In the Adobe Town allotment, the S&G evaluation found that Carson Spring Reservoir was Functioning-At-Risk with a static trend, and Moonshine Springs was rated non-functioning due to livestock and wild horse use (picture 41-1). The reservoir has already been cleaned and no additional work has been identified for Carson Spring. Moonshine Springs is currently being repaired.

The 1999 S&G evaluation in the Grindstone Springs allotment found that Grindstone Spring itself was Functioning-At-Risk with a downward trend due to wild horse use (picture 41-2). This spring is also currently being repaired.

The Sand Creek allotment was also evaluated in 1999 for S&Gs, and the Hartt Cabin artesian well and a seep were found to be Functioning-At-Risk with a downward trend, also due to wild horses. Both of these sensitive riparian areas will be excluded from livestock and wild horse use in the fall of 2002.

Lastly, Red Creek allotment was found to have a seep Functioning-At-Risk during the 1999 S&G evaluation. This riparian area will be developed and fenced to exclude use during 2003.

The above allotments have all been addressed regarding livestock grazing since their initial assessments. However, wild horse impacts continue throughout the area. A gather has been is scheduled for the last two years, but until the numbers of horses are at AML, their impacts continue throughout the area. Even when the numbers reach AML, the impacts of yearlong grazing in sensitive areas will continue to occur.

4) Reference Conditions:

As stated in Standard 1, the Stansbury expedition noted small willows and currant bushes and farther upstream there were many more willows, currant-bushes, and birch, and several beaver dams. Loss of this important woody component is an identified concern within the basin. There are only a few areas that may hint at the relic conditions. Littlefield Canyon shows a marked difference in species composition from an allotment that was heavily utilized by livestock and an allotment that has been historically lightly-used. Only willow remains where there was historical heavy use, but below the fence a much more diverse community consisting of dogwood, golden currant, water birch, and alders is prevalent. Many of these species tend to be selected for by grazing animals and also tend to be unarmored. Those species that are more resistant to grazing, less desirable, or armored by thorns or stickers tend to remain. On a widespread basis, perhaps much of the upper watershed provided a more diverse shrub community than is currently present.

Savery Creek was wooded with willow thickets according to Fremont. In this same watershed, McCarty Creek is very similar to the way Savery Creek was described. This creek was primarily used by sheep and tended to be used in a way by livestock that maintained the healthy willow community ("thicket") that was noted as prevalent in the area. The creek is lined with willows and has numerous beaver dams throughout. In lower gradient areas, huge expanses of beaver ponds are common.

The Little Snake River was classified as a considerable stream wooded with cottonwood and thickets of willow and buffaloberry. The valley remains this way today. Miles of cottonwood galleries are common along the main channel and in the lower drainages flowing into the Little Snake River.

Barrel Springs was referred to as "abrupt gullies and ravines, formed by the wash from the hills, and in many places the ground is covered by a crust of impure soda to the depth of half an inch. The little stream whose valley we had followed to the Gate, pursued a wandering course to the south-east through the prairie, its existence marked only by an occasional clump of willows." This is very similar to the way this area looks today. Springs and seeps in the area tend to support a riparian grassland that is saline-influenced and usually intermingled with greasewood-dominated saline lowland. Herbaceous species are varied and include alkali sacaton, inland saltgrass, basin wildrye, spike sedge, Baltic rush, Nebraska sedge, alkali bluegrass, wheatgrasses, arrowweed, sea milkwort, cinquefoil, and other forbs. Light stocking rates, dormant season of use by cattle, and minimal use by sheep has maintained this area. Within its capability and potential, this area demonstrates healthy riparian production and water availability.
Riparian areas (and uplands for that matter) throughout the area evolved over millions of years as a natural grazing ecosystem. The fossil record in the Intermountain West indicates herbivory in the past was comparable to the Serengeti in diversity (Burkhardt, 1996). Burkhardt also summarized other studies of the presence of large herds of bison and their existence in this region until the early 1800s. Large herds of bison grazed this entire assessment area; a bison skull was found buried in Littlefield Creek Canyon in the upper watershed, and many others have been found west of Highway 789.

5) Synthesis and Interpretation:

Muddy Creek has always been a high priority for the Rawlins Field Office and has had additional attention and several studies by the University of Wyoming in the 1980s. Information gained from these studies include bank sealing by clay particles, requiring overbank flows to provide moisture to sustain bank vegetation, otherwise coyote willow and other riparian species die back due to lack of water even though there is water in the stream channel. Root growth studies of willow stem plantings showed that bank stability can be enhanced with willow plantings (picture 42-1). Using this knowledge, over ten miles of stream channel have been planted with willows to speed up restoration of riparian habitat (picture 42-2). This research and use of portions of the Muddy Creek watershed as a demonstration area has resulted in very positive improvement throughout the assessment area. Projects including reservoirs, stream structures, and the extensive system of spreader dikes clearly demonstrate the commitment to improve this area over the years. In the early 1990s the LSRCD formed a Coordinated Resource Management (CRM) Group for the upper Muddy Creek watershed. This area included the area south of I-80, west of Hwy 71, and east of Hwy 789 to the Savery Creek watershed. The original goals of the group included:

1. Increase cooperation, coordination, and trust among landowners, permittees, agencies and interest groups.
2. Improve critical ranges for antelope, elk, and deer in the area.
3. Demonstrate that properly managed livestock grazing can be compatible with consumptive and non-consumptive use of the area
4. Improve water quality and reduce erosion and sedimentation. Restore the riparian habitats to their desired future condition. This will consist of visible changes in the plant community, stream channels, and hydrologic regimes. It includes improvement of existing woody plant communities and their restoration to previously occupied sites.
5. Reestablish Colorado River cutthroat trout to headwater streams.
6. Manage upland habitats to improve their biodiversity and productivity for selected wildlife species and domestic livestock.

This CRM effort has received national attention and funding through organizations such as the National Fish and Wildlife Foundation, EPA 319, CUP, and was an original Seeking Common Ground award recipient. Demonstrating significant riparian improvement has led to the production of videos to spread this cooperative effort in rangeland health improvement on a larger scale. Since the time of the original CRM formation, efforts and involvements have reached past these boundaries and are prevalent throughout the assessment area. As stated earlier, much of the area has already greatly improved due to implementation of best management practices, a few examples of which follow.

Historic heavy livestock use by sheep and cattle in numbers and chemical treatment of willow communities greatly degraded the riparian systems in the Grizzly allotment. This allotment is in the upper Muddy Creek watershed and provides the headwaters of Muddy Creek, Little Muddy Creek, and Littlefield Creek. Willows were mushroom shaped (if they were present), Kentucky bluegrass and dandelion dominated the riparian community, and bank erosion was widespread. The allotment was finally addressed and received two years rest, and then a new allotment management plan (AMP) was implemented. The allotment had an old AMP; however, it was not followed and needed modification to adequately address riparian concerns. The Wyoming Game and Fish Department attained the base property in the early 1990s and leased the grazing to Desert Cattle Company. Numerous improvements have been implemented since that time, many of which were paid for by LSRCD through the EPA 319 funding, BLM, and WGFD. These include: three cross-fences, several spring developments and reservoirs, five vegetation treatments, stream structures, and plantings. These improvements have resulted in shorter grazing duration, better livestock distribution and quicker restoration of the riparian systems (pictures 43-1, 43-2). In addition, one of the original goals of the Muddy Creek CRM was to reestablish Colorado River cutthroat trout; that was achieved in the fall of 2001in Littlefield Creek. As part of that reintroduction effort, the main stem of Muddy Creek and East Muddy are the next location for the trout.

In 1991, the WGFD established Habitat Quality Index (HQI) sites to monitor fishery habitat in the trout reintroduction area. HQI is a tool that can be used to assess fluvial trout habitat. Most of these sites have shown improvement since they were put in. A representative site of this monitoring along lower Littlefield Creek is depicted in Table #3 below:

TABLE #3 - STREAM HABITAT COMPONENTS

Components	1991	1993	1995	1997	1999	2001
Average stream width (ft)	5.9	5.0	4.8	5.2	5.1	4.3
Average stream depth (ft)	0.4	0.7	0.7	0.4	0.6	0.6
Stream Flow (CFS)	0.9	1.4	1.4	1.4	2.2	1.6
Cover (%)	13	15	15	11	11	33
Eroded banks (%)	10	20	38	5	3	11
HQI Score	2.9			5.7	4.2	6.1
Habitat Unit	8.5			11	9.7	11.5

There are some variations upward and downward over the years, due to specific grazing management during that year and seasonal differences between years. However, the entire upper watershed has responded overall and continues to improve.

The Morgan Boyer allotment in the southern portion of the watershed has one of the highest stocking rates within the field office and has five permittees. By implementing management tools such as drift fencing, upland water development, prescribed burning, vegetative plantings, and instream structures, the riparian area was greatly improved and the stocking rate was maintained. In this case, riparian willow greatly benefited from the improvement in management. Grazing use along the creek kept the young regeneration of whiplash, Geyer, and Coyote willows at less than six inches tall. Since the improvements were implemented in 1992, willows and cottonwoods are already 6-12 feet tall (pictures 43-3, 43-4). This stream system and others throughout the region are often dominated by sedges, with Nebraska sedge the most common species (picture 43-5). It is a deep-rooted, rhizomatous species that helps to stabilize banks, is productive, and very nutritious. Another species of interest is American mannagrass (picture 44-1). Severely reduced by season-long cattle use, this plant species is observed along most streams where rotation and deferred rotation grazing systems have been implemented. It is similar to Nebraska sedge in terms of helping stabilize banks, being nutritious, and is easily observed with its big flowering head waving three to four feet in the air along creeks.

The Doty Mountain allotment is grazed by one permittee, Weber Ranch, and is located on the middle portions of Muddy Creek. Range improvements including pasture fencing, stream structures, vegetation treatments, and water developments have resulted in enhanced riparian function. Although Muddy Creek in this area was historically downcut and in some cases has 10-15 ft sidewalls, within that new floodplain a healthy riparian area has been established. Given the potential of this riparian area, substantial improvement has been documented over the past years. Vegetation has changed greatly within the riparian zone. Species shifted from annuals and early successional species to more long-lived riparian species. In several cases, willow, sedge, and rush species, which are important for bank stabilization, were found in 1997, where none existed in 1989. In three different cross-section locations, the riparian area was dominated by bare ground and early successional plants. Within eight years, the dominant plants were perennial riparian species, including several grasses, wild licorice, bulrushes, and coyote willow.

In the Savery Creek drainage, the Savery Creek allotment supports riparian areas that are rated as properly functioning. The permittee, Tall Grass LLC, constructed crossfences and spring developments and has a longterm vegetation treatment schedule planned to continue improvement; unfortunately, historic photos are not available. Tall Grass LLC has also acquired a new allotment to the north (Morgan Creek allotment) in which it has constructed a crossfence and developed springs in the one year it has managed the allotment. Riparian conditions have greatly improved due to more intensive management and consequently shorter duration of use. This improvement has been achieved through efforts and investment of the permittee, with some assistance from NRCS and BLM.

One of the most important benefits of improved riparian health in this area is the support and cooperation of all those involved. A commitment by all parties in the area has resulted in substantial improvements in riparian health, and even more importantly, a dedication to continue these successes and promote riparian health outside the area. Cooperation by permittees, federal and local government, conservation groups, and many other entities have made this improvement possible. A list of all cooperative entities in this ever-expanding project is part of the CRM literature.

Another positive outcome of this cooperative effort is the support of the groups involved. Any proposal to try a new method or solution is supported in order to see if it is successful. Several of these experiments have resulted in riparian improvement. Limiting road width, construction of waterbars and digging roadside pits to catch sediment have resulted in riparian improvement. In many cases, the upper Muddy Creek watershed was viewed as an experimental area. If projects worked they were implemented elsewhere. Even if a experiment is not successful, the group is still supportive and willing to continue to try innovative solutions. Currently, McCarty Creek has some severe erosional problems due primarily to the county road location. Cooperative efforts between the BLM and the Carbon County Road and Bridge Department will address these problems in an effort to reverse the riparian degradation.

Although many of the riparian areas have been addressed, some still need attention. Rasmussen subunit allotment historically had several permittees, and Bird Gulch was identified as one of the worst riparian areas within the assessment area. By constructing division fences and creating separate allotments, riparian condition has improved for the most part. A chronic trespass problem on the lower end and more degraded condition continues to be a problem. A crossfence has been proposed, and upland vegetation treatments, as well as a more substantial enforcement of livestock supervision, are necessary.

In the wild horse herd areas, the issues are much more problematic. Increased horse numbers and no control of their use results in the degradation of important riparian areas. Livestock use is being addressed; however, until wild horse numbers are reduced and a more efficient management regimen of these animals is implemented, conditions will continue to suffer. The reduction of wild horse numbers is a vitally important step.

6) Recommendations:

There has been a tremendous improvement in riparian/wetland condition within the assessment area over the last 15 to 20 years. However, there are still areas that need attention. Allotments containing riparian/wetland habitat that do not meeting this standard have been described previously and include: Cherokee, Sulphur Springs, Standard, Rasmussen, Sage Creek, Pine Grove, Powder Mountain, Powder Rim, Cow Creek, Espitalier, Adobe Town, Grindstone Springs, Sand Creek, and Red Creek allotments. For lotic systems that are not meeting the minimum standard, there are 119 miles out of a total 319 miles. In lentic sites, there are 5 acres of a total 17 acres, that do not meet the minimum standard.

Most of the lentic and lotic sites not meeting the standard have been, or are in the process of being addressed in management plans or as range improvement projects. Continued progress in grazing management of livestock and wild horses(where they are present) will ensure further improvement of all riparian areas within this area. Although there are areas where desired future condition is yet to be reached in woody species dominance and composition in the upper watersheds, these areas still meet the minimum standard of rangeland health. Other than the specific allotments listed previously, the remainder of the allotments within this assessment area are meeting Standard #2 – Riparian/Wetland Health.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for riparian habitats. Specific dates and timing of use must be determined on a case-by-case basis. Methods to achieve this include, but are not limited to: herding, additional fencing, water developments, and vegetation treatments. Address trespass livestock problems, particularly where it is not the livestock operator permitted within an allotment.

Identify and correct impacts from improved roads, including water flows and erosion into riparian systems. Two-tracks that are negatively impacting riparian areas should be identified and addressed.

Continue plantings within the watershed. Hundreds of woody shrubs have been planted throughout the watershed with varying degrees of success. The LSRCD, in conjunction with the NRCS, has also developed some planting trials in the upper watershed to compare different species' establishment success. In addition, in lentic areas both woody and herbaceous species have been planted with high levels of success. In many cases, these manmade wetlands don't have the desired natural diversity of wetland plants. When just a few individuals are planted, they establish exceedingly well.

It is critically important that the numbers of wild horses in the assessment area are reduced to AML as soon as possible. Impacts to riparian resources in these areas will continue as long as wild horses are present in the area. However, this degradation will be greatly reduced when horse numbers are reduced and subsequently maintained at that level.

Continue existing projects to protect riparian habitat and provide off-site water for wild horses and livestock.

Continue to expand the beneficial practices that improve riparian health and maximize public involvement and education regarding resource issues.

STANDARD 3 – UPLAND VEGETATION HEALTH

Upland vegetation on each ecological site consists of plant communities appropriate to the site which are resilient, diverse, and able to recover from natural and human disturbance.

Vegetation in the Upper Colorado River Basin watershed in this assessment area is a mix of a variety of habitat and range types, interspersed within and between, and/or transitioning from one to another. An assortment of environmental factors influence the location(s), extent, seral stage(s), and/or types of vegetation found throughout the area. Elevation, precipitation zone, topography, soils and underlying parent materials, slopes, and exposures all contribute to the general vegetation composition throughout the watershed. In order to simplify the overall descriptions of vegetation types, this analysis will address vegetation types in relation to the elevation and topography in which they occur (and additionally closely tie to the associated precipitation zones), beginning at the highest portions of the watershed and descending to the bottom of the analysis area.

1) Characterization:

As mentioned in the background section, the most common vegetation type within the watershed is the sagebrush-grass type, which occurs to varying degrees (and with varying composition) throughout the elevation and precipitation ranges of the study area. Interspersed throughout the landscape are other assorted communities including sagebrush/mountain shrubs, saltbush steppe, greasewood lowlands, juniper woodlands, and aspen woodlands, as well as badland type communities containing limited vegetation. Additionally, various combinations of communities and limited inclusions within specific community types are common.

From the highest elevations analyzed in this document (around 8,500 ft) to a level of around 6,500 ft, the sagebrush-grass community is dominated by mountain big sagebrush (picture 46-1). The mountain big sagebrush-grassland community occurs throughout the foothills and bases of mountain ranges and is intermixed with and surrounds many conifer and/or aspen woodlands. Shrub heights range from 10 to 30 inches, and canopy cover can reach up to 50 to 60%. After removal, mountain big sagebrush is relatively quick to re-colonize, reaching predisturbance levels in as little as 20 to 30 years. Understory herbaceous species include buckwheat, larkspur, lupine, paintbrush, mulesear wyethia, yarrows, Oregon grape, and penstemons. Grasses found in these communities include green and Columbia needlegrass, elk sedge, mountain brome, king-spike and Idaho fescue, Kentucky and big bluegrasses, and slender, thickspike, bluebunch, and western wheatgrasses. In many instances within the sagebrush community at these elevations, a large percentage of the overall shrub community is comprised of various other mountain shrubs including serviceberry, snowberry, antelope bitterbrush, mountain mahogany, chokecherry, and rose. Lying in sandier sites at these higher elevations, the sagebrush-grassland community may be intermingled with bitterbrush shrub-steppe type communities, where antelope bitterbrush is either the dominant shrub species or is co-dominant with other mountain shrubs (picture 46-2). Along some of the higher, windswept ridges, limber pines can be found clinging to the shallow soil.

At these relatively high elevations and precipitation ranges, and limited to somewhat sheltered areas where more moisture is gathered and retained throughout the year (mostly in steep draws facing north and/or east and along the slopes immediately adjacent to and climbing out of perennial and/or ephemeral riparian bottoms), small stands of so-called “dark timber” can be found in isolated, scattered locations. These stands are limited to the highest and wettest pockets of the evaluation area, occurring along the high slopes between Savery Creek and Loco Creek and along the northern portion of the west Sierra Madre front, including slopes adjacent to and/or above Sandstone and Little Sandstone Creeks and Hell Canyon, and the slopes along Dirtyman, Hartt, and Mill Creeks (picture 46-3). Vegetation in these pockets is dominated by coniferous trees intermixed with aspens and various understory shrubs, grasses, and forbs which can withstand being shaded by the overstory. Overstory tree growth includes subalpine fir, lodgepole pine, and aspen. Although limited by litter and shading, understory species within these stands includes species such as shrubby cinquefoil, currents, and woods rose.   An additional vegetative community that occurs in limited abundance along the west slope of the Sierra Madres is a Gambel oak-dominated community which is extremely similar to the mesic upland shrub type, but dominated by dense thicket-like stands of Gambel's oak. The overstory ranges in height from small shrubs of around five to six feet to mature trees as tall as 15 feet. Understory species are similar to those found in aspen stands and mesic shrubs stands such as dense serviceberry or chokecherry stands. As the southern portion of the Sierra Madre Mountains in Wyoming is the northernmost extent of this vegetation type, and since this vegetation type occurs at higher elevations and wetter areas than are found throughout most of the analysis area, it is relatively scarce, occurring (on BLM-managed rangelands) only along the south (north-facing) slopes of Little Sandstone canyon.

Limited to sites that are inherently wetter or retain moisture for longer periods (mostly north and east facing bowls and slopes which trap more winter snow and suffer less from evaporation), aspen woodlands are scattered throughout the high-to-mid-level elevations in the area (picture 47-1). Obviously dominated by aspens, understory species include snowberry, serviceberry, Scoulers willow, creeping juniper, rose, Oregon grape, geranium, bluebells, elkweed, columbine, licorice-root, sweet cicely, aster, elk sedge, Columbia needlegrass, blue wildrye, mountain brome, and slender wheatgrass. Forage is limited by litter/leaf cover and shading of the floors of the stands. Aspen stands are limited to the eastern portion of the watershed, carpeting the foothills of the Sierra Madre Mountains along its entire west front, and continuing in scattered locales to the west slopes of Muddy Mountain and along the higher portions of the Deep Creek, Cherokee Creek, Wild Cow, Cow Creek, and Deep Gulch drainages. West of Highway 789, only rare, tiny, remnant aspen patches are encountered at high, wet locations (several instances on the Flat Top Mountains) and contain aspen overstory sparse enough that it would be more correctly classified as a mesic upland shrub type. Common at the higher elevations, and in many cases surrounding and/or intermingled with aspen stands, the mesic upland shrub steppe vegetation type is widespread. It is dominated by serviceberry and/or chokecherry and occurs on moderately-deep to deep soils. The dominant shrubs in this type can reach heights of ten to fifteen feet and occur in open to dense stands. Understory species include snowberry, rose, and currants, along with basin wildrye, green and Columbia needlegrass, Kentucky bluegrass, bluebells, columbine, aster, violets, elkweed, chickweed, and stinging nettle.   Both aspen and mesic shrub types respond well and quickly to disturbances.

As elevation is lost and the corresponding moisture regime drops, mountain big sagebrush begins to intermingle with and give way to Wyoming and basin big sagebrush stands and big sagebrush/grass/mountain shrub mixtures. Mountain shrub vegetation types encountered throughout this zone on shallow soils and/or shallow rocky sites include relatively monotypical and intermingled xeric upland shrub steppe sites. This vegetation type contains true mountain mahogany, in some cases as the dominant shrub species, but more often intermixed with other mountain shrubs including bitterbrush, snowberry, serviceberry, and basin big sagebrush (picture 47-2). Dependent on soils, precipitation, and browsing levels, the dominant shrubs may reach up to five to seven feet in height. Common understory species are green needlegrass, needleandthread, bluebunch wheatgrass, Indian ricegrass, Sandberg's and mutton bluegrass, and mat forbs such as phlox, buckwheat, locoweed, and goldenweed.   Wetter sites nestled within the rolling terrain are dominated by stands of basin wildrye.   A relatively unique, shrub-dominated vegetation community is located in the Sand Hills/Doty Mountain region of the analysis area, influenced heavily by the sands soil type in which it occurs. This vegetation type occurs within the 10 to 14-inch precipitation zone and is dominated by a mixture of antelope bitterbrush and basin big sagebrush, silver sagebrush, rabbitbrush, needleandthread, prairie sandreed, and Indian ricegrass. This vegetation type also includes a high occurrence of a "berry" group, including snowberry, serviceberry, chokecherry, and rose.

As the transition to lower elevation progresses, Wyoming big sagebrush takes the place of mountain big sagebrush on the shallow to moderately-deep soil sites, and basin big sage dominates shallow draws and swales where deeper soils occur within the sagebrush-grass communities (picture 47-3). The xeric upland shrub steppe type is found at these elevations, where mountain shrubs tend to become dominated by mountain mahogany and bitterbrush that tolerate drier conditions. In wetter areas (draws, areas near seeps, north and east-facing slopes), instances of the previously-described mesic upland shrub steppe vegetation type can be found. Throughout the sagebrush-grassland communities at these elevations, rubber rabbitbrush, winterfat, and low rabbitbrush, as well as shadscale and gray horsebrush, are interspersed with the sagebrush (picture 48-1). Grasses in the understory include slender, bluebunch, and western wheatgrasses, needleandthread, prairie junegrass, Indian ricegrass, Sandberg bluegrass, and bottlebrush squirreltail (picture 48-2). Forbs that thrive in the understory include phlox, penstemons, Hookers sandwort, buckwheat, locoweed, and cryptantha. Additionally, greasewood begins to appear in the more saline areas.

Juniper woodlands tend to become the predominant vegetation type (other than sagebrush-grass) at middle-to-lower, drier elevations and are comprised of Utah juniper, which ranges from a dense to relatively open overstory (pictures 48-3, 48-4). They lie over terrain as varied as the (relatively) flat surfaces of plateaus, along rolling hills and ridgelines and up steep slopes, along the knife-edges of rimrock cliffs, and into rocky breaks and broken draws. Understory shrubs continue to be dominated by Wyoming big sagebrush on deeper soils, (and some basin big sage). Although scattered throughout the mid-to-lower elevations of the analysis area, the heaviest concentrations of this vegetation type are found along Wyoming Highway 789 between Muddy Creek and Baggs (the Dad junipers, Wild Horse Peak), along the Colorado border from Savery to Baggs, the Red Creek drainage south of the Flat Top Mountains, and along the length of Powder Rim. Xeric upland shrub steppe communities are intermingled with this vegetation on shallower soils, including true mountain mahogany, bitterbrush, and winterfat. This combination of Utah juniper and true mountain mahogany is most pronounced in the area between Poison Basin west of Baggs and the easternmost extents of Powder Rim. On sandier soils, the bitterbrush shrub steppe occurs, usually dominated by low-growing antelope bitterbrush at these elevations. Lupine, cryptantha, paintbrush, penstemons, sego lily, onion, and prickly-pear cactus are common forbs. Indian ricegrass, needleandthread, and Canby bluegrass are represented in the herbaceous understory, as well as the ever-present thickspike, bluebunch, and western wheatgrasses.

At the lowest elevations in the (analyzed) watershed area, sagebrush-grass vegetation types continue to be typified by Wyoming and basin big sagebrush, interspersed with lowland shrubs including greasewood, horsebrush, spiny hopsage, and rabbitbrush (picture 48-5). An upland silver sagebrush-grassland vegetation type can be found in some areas at this elevation interspersed with the Wyoming and basin types where deep sand soil types underlay the vegetation. Typified by silver sagebrush either singly or mixed with basin big sage and/or green or Douglas rabbitbrush, it can reach heights of three to five feet, with a relatively high canopy cover of up to 50%. Understory species are typical of those found in sandy soils: needleandthread, prairie sandreed, Indian ricegrass, sand dropseed, scurfpea, cryptantha, and/or prickly-pear cactus. Another community influenced by sandy soils is associated with the lower elevations of the analysis area, appearing on slightly-raised, stabilized sand dune features scattered throughout saline uplands and lowlands and shale-type flats (picture 48-6). Relative to the surrounding flats, these communities are extremely productive and are dominated by big sagebrush and spiny hopsage and include associated species such as needleandthread, Indian ricegrass, sandhill muhly, greasewood, rabbitbrush, and thickspike wheatgrass. These low-precipitation stabilized sand dune sites are located west of Sand Creek towards the Adobe Town badlands and above the western edges of Adobe Town across the flats to the base of Kinney Rim to the west. As soils become more saline, salt-tolerant species tend to dominate, and the sagebrush-grass type is replaced and interspersed with the saltbush steppe-type community, dominated by Gardner’s saltbush, bud sagewort, shadscale, winterfat, and birdsfoot sagebrush (picture 48-7). Birdsfoot sagebrush is also found on more alkaline soils with higher pHs. On flats with higher pHs, it is found in mostly pure stands and along slopes or ridges and/or as the pH drops, it becomes mixed with species such as Nuttall’s saltbush and other grasses and forbs. Understory species that are found in these communities include winterfat, western wheatgrass, Sandberg’s bluegrass, Indian ricegrass, bottlebrush squirreltail, threadleaf sedge, phlox, hooker sandwort, buckwheat, and other mat forbs. Within the analyzed watershed area, these sites occur primarily west of Muddy Creek and north/northwest of the Red Creek drainage. Greasewood flats become more common (although scarce relative to sagebrush-dominated communities in this area), occurring on lowland flats where, for one reason or another, the vegetation is influenced by high salinity and seasonal water (sometimes standing), where other, higher shrubs tend to be excluded (picture 48-8). In some cases, these sites are interspersed with Nuttall’s saltbush. The understory herbaceous component contains phlox and asters, Indian ricegrass, Sandberg bluegrass, needleandthread, western wheatgrass and squirreltail. Another low sage type found at these elevations and precipitation zones is the alkali sagebrush type, which occurs in clay soils (picture 48-9). It occurs in relatively pure stands and grows to between six and eighteen inches in height. Intermingled vegetation species found within these communities are very similar to those found in the other low precipitation, low sagebrush communities. This vegetation community is most prominent to the north/northeast of Baggs in the lower Cherokee and Deep Creek drainages.

Finally, interspersed throughout mostly the middle and lower-elevation portions of the system, badland-type sites are spread haphazardly, consisting of relatively low-production vegetation types with very little soil accumulation and/or ground cover (picture 49-1). The soils and underlying parent materials in badland sites are very soft and highly erosive, and the landscape is cut with a large number of drainage channels. Vegetation in these sites, although sparse, contains species ranging from Wyoming big sagebrush and antelope bitterbrush to scattered bunchgrasses (including Indian ricegrass and needleandthread). Although scattered throughout the analysis area, badlands primarily occur west of the Flat Top/Red Creek drainage area and become concentrated and extensive from Sand Creek to the Adobe Town area east of Cow Creek Reservoir and Kinney Rim.

Principal human uses throughout the area, which impact the vegetation resource, tend to center around allocations of forage for livestock and wild horse grazing (in some cases and/or areas, forage is not specifically allocated to either, and may by used by wildlife), removal of native vegetation during the course of mineral exploration and extraction, and recreation uses. Additionally, vegetation in the watershed is directly influenced by human activity through the application or repression of intentional and/or naturally occurring “vegetation treatments,” including wildfire, prescribed fire, chemical, and mechanical vegetation removal.

Livestock use at higher elevations is comprised of cattle and/or sheep grazing. Seasons of use at these elevations is restricted to late spring, summer, and early fall, during which time the area can be accessed and the vegetation utilized by grazing ungulates – snow usually precludes year-round use. Cattle operations vary between grazing of cow-calf pairs, yearling steers, and yearling and/or second-year heifers. Grazing use occurs during various portions of the spring/summer/fall seasons, ranging from season-long to deferred and/or rotational use. Sheep use of the higher portions of the watershed consists mostly of late-spring and early summer use for lambing grounds and as holding areas for use prior to trailing the bands on to the forest. Early-to-mid-fall use is made as bands of sheep are dropping from the forest and on the way to winter grounds at lower elevations. At the mid-to-lower portions of the watershed, summer cattle use is made either seasonally or through rotation of livestock through use areas. Summer cattle use in various configurations is made throughout the majority of the watershed at mid-to-low elevation levels. Although summer cattle use occurs in many of the lowest allotments in the watershed, perhaps more predominantly, winter sheep use is made throughout many of these grazing allotments, rotated through the use areas by herding. In some scattered allotments, cow-calf pairs make winter use of the forage.

Recreation primarily takes place during the late-summer and fall months as hunting (mid-August through November), although limited summer use occurs throughout the area, and springtime recreational uses such as shed-antler hunting continue to increase at an accelerated pace. Associated with this use are an ever-increasing number of roads, trails, and tracks, which wind through all of the vegetation types and are restricted only by topographical impediments.

Vegetation in the western two-thirds of the watershed area is also impacted by extensive oil and gas field development, and an ongoing exploratory development for coalbed methane extraction is located east of Highway 789. Associated with this mineral extraction are networks of (mostly) improved access routes.

Additional human uses of the watershed include commercial seed collection, off-highway vehicle use not associated with the previously-mentioned activities, the collection of moss-rock for commercial decorative purposes, and removal of wood products (almost exclusively juniper) for firewood, fenceposts, and furniture. All of these activities influence the vegetative component of the watershed where they occur, either indirectly via associated changes, or directly by contact with and/or removal of vegetation.

2) Issues and Key Questions:

Removal of vegetation in the form of grazing forage for large ungulates has been and continues to be the principal factor affecting vegetation throughout the Little Snake River watershed. Domestic livestock grazing tends to provide the most impacts to the vegetation of the watershed, throughout its area, although localized portions of the watershed (or specific vegetation communities and/or species) may by more influenced by grazing by wild horses or wildlife.

Through varied management processes, including rangeland inventories, management agreements and grazing plans, and implementation of various "best management practices," stocking rates have been adjusted to fit available livestock forage on public lands throughout the watershed since inception of the Taylor Grazing Act. Because of these adjustments, livestock management issues relate to the season, duration, and distribution of use rather than stocking rates (although limited exceptions exist.) These issues are primarily directed at impacts to sagebrush/grassland and sagebrush-mountain shrub/grassland vegetation types in the form of the following impacts:

- Uneven use patterns (heavier grazing use associated with reliable water sources as opposed to light to nonexistent forage utilization in other, more isolated locations). Heavy historic use along Muddy Creek probably led to an expansion of prickly-pear cactus (picture 50-1).

- Shifts in vegetation species types that favor increaser forage species (e.g., western wheatgrass) and aggressive warm-season annuals over cool-season, perennial vegetation types (such as bunchgrasses) where uninterrupted, season-long livestock grazing occurs (picture 50-2).

- Variations in herbaceous vegetation availability where season long and/or growing season livestock use has pushed more desirable forage species from open, "easily accessible" locations (spaces between shrubs) to more protected, "sheltered" spots (e.g., under and within sagebrush and other shrubs.) This allows less desirable species such as rhizomotous, single-stalked grasses (e.g., western wheatgrass) to colonize and spread, thus lowering overall ground cover and forage value.

The key question that arises from these impacts focuses on implementation and refinement of best management practices for livestock grazing. What opportunities exist to implement or refine best management practices for livestock grazing or other actions that will maintain and/or improve the overall health and value of upland vegetation and meet desired resource conditions and allow for grazing of the vegetation resource use by domestic livestock as called for under the Bureau's multiple use mandate?

Vegetation use by wild horses occurs in a large portion of the watershed unit, west of Wyoming State Highway 789, and is managed only to the extent that the population of horses should be maintained at an AML. In areas where wild horse populations exist within the watershed, impacts to vegetation from their grazing can be considered as important as those from livestock grazing to the health of the resource. Because wild horse populations are restricted to only a portion of the analysis area, they could be considered to have less impact than the livestock grazing which occurs throughout the watershed. However, the herd management area encompasses many soils that are highly erodible, which may contribute additional sedimentation into the upper Colorado River if vegetative vigor and cover are not maintained. Impacts to vegetation from wild horses are similar to those from livestock grazing in that they relate to season, duration, and distribution of use, but also include stocking rates. Due to the Bureau's inability to achieve AML for the Adobe Town HMA and surrounding area, year/season-long forage utilization has occurred on vegetation within this area for the last several years at levels far in excess of that deemed appropriate. Impacts from horse use are primarily to sagebrush/grassland, saltbush shrub steppe, and juniper woodland vegetation types, resulting in heavy utilization levels, uneven distribution patterns, shifts in species types, and variations caused to species diversity, location, availability, and distribution. The key questions to ask in order to deal with these impacts include finding how to manage the distribution and seasonal use of an ungulate species that utilizes vegetation throughout its range in an uncontrolled, yearlong manner. Additionally, how can the BLM mitigate political and logistical problems that have prevented it from meeting its management responsibilities for these animals and the rangeland resource?

Policies that govern the use of vegetation treatments and the suppression of such vegetative community alteration, have played and continue to play an important role in the existing make-up and continual alteration of vegetation in the watershed (picture 51-1). Aggressive wildfire suppression, and an inability to successfully implement manipulation of shrubland communities within the watershed at the level which is required, has led to a predominance of uniform, older age-class shrub stands throughout the analysis area. Additionally, aspen woodlands appear to be declining in health and abundance, and conifer/juniper encroachment into these and other shrub stands appears to be increasing with time. A large percentage of sagebrush and mixed sagebrush/mountain shrub stands have reached a level of overly mature to decadent, leading to lower herbaceous ground cover, species diversity, plant vigor, forage, and nutritional value (for livestock and many big game wildlife species.) Additionally, large, uninterrupted expanses of vegetation allow for large-scale losses of key habitat types if and when natural disturbances occur. The key question is how do the BLM and other natural resource management agencies and partners determine the level of vegetation treatment which should occur in order to promote better overall vegetation health while balancing the need for diversified habitat requirements of many user species? To what extent should portions of key vegetation types and habitats be temporarily altered in order for the overall health of the vegetation/habitat/watershed be maintained or improved? At what level of vegetation alteration does temporary habitat loss outweigh long-term vegetation health maintenance and/or improvement?

The next most important factor relating to upland vegetation health throughout the watershed is use of varied vegetation resources by native wildlife, in particular, ungulate big game species. The principal issues that should be addressed regarding big game management relate to seasonal habitat forage requirements for mule deer, elk, and pronghorn antelope. Although transitional, winter/yearlong, and crucial winter ranges for all species have traditionally been the habitats of concern (limiting the populations), relatively recent research has elevated the importance of quality spring/summer/fall habitat to healthy individual and population conditions. Key questions to be addressed include how to manage vegetation resources on key seasonal habitats to provide adequate quality forage for wildlife species, yet continue to provide forage for seasonal, managed livestock use. How can the mix of uses of the vegetation resource in the watershed be managed so that vegetative health is maintained or enhanced? Additionally, how do the principal players involved in the management of vegetation and wildlife within the watershed balance the sometimes necessary impacts of multiple use management (and/or livestock management) activities with habitat requirements on seasonal big game ranges?

Another influence on vegetation health in the watershed is the presence and expansion of oil and gas field development, which, although existing in parts of the watershed for a rather long time period, has been relatively recently introduced to other portions (but is increasing extremely quickly across the region.) Short-term vegetation losses occur with every pad and access road that is constructed, but can be mitigated comparatively quickly with adequate reclamation after the initial activity subsides, sometimes to the point of increasing vegetative production over predisturbance levels. This can also be an opportunity to beneficially impact species composition and age class diversity. Good reclamation practices are abundant throughout the watershed, but poor, or unsuccessful reclamation attempts are also plentiful. When reclamation is unsuccessful or not attempted, impacts to vegetation are not limited only to direct changes (loss of vegetation on pad and road locations), but can expand to indirect impacts, including shifts in species composition and community diversity which appear in the form of increaser and/or invader species such as annual cheatgrasses along road and pipeline right-of-ways and the spreading of halogeton in oilfield road complexes. Additionally, seismic exploration has increased dramatically in the region. Although this exploration is supposed to be low impact, these activities do create new roads, which are then used and made more permanent by recreationists. The key question that should be addressed in regards to these impacts is how to elevate levels and enforcement of reclamation standards in order to mitigate long-term impacts to the vegetation. Oil and gas activities have also caused damage to cattleguards, braces, and fences, much of it either not timely or properly repaired. This results in unwanted wild horse and livestock use in adjacent allotments and increased maintenance and management costs to livestock operators. How can timely and proper construction techniques be enforced?

Finally, a dramatic increase in the expansion of unimproved roads and trails, and an obvious increase in the amount of off-highway vehicle (OHV) use, is apparent throughout the watershed. This use is most associated with general recreational activities by the public and is not usually associated with development actions described previously (although those actions may alter the landscape in ways that encourage further OHV expansion.) The popularity and affordability of small, all-terrain vehicles leads to their use farther and farther into previously remote and unroaded areas, creating or "pioneering" unauthorized and illegal trails through the vegetation wherever possible, which are then repeatedly traveled until vegetation is lost along the route, and it becomes a road for all practical purposes. As the only barriers to this travel are terrain and rules governing off-highway travel (which are difficult to enforce), only vegetation in the roughest topography is currently or potentially free from this disturbance. This disturbance leads to vegetation shifts and losses similar to those associated with the expansion of oil and gas exploration and extraction, but extend into much longer-term time frames as there is no reclamation of the disturbance unless a pioneered road or trail is left to naturally revegetate through a lack of use (which, with ever-increasing recreational use of these lands, rarely, if ever, happens). Additionally, recreational OHVs are not subject to minerals management stipulations designed to mitigate the spread of weed seeds, and so have the potential to add weed infestation to their impacts. The key questions which should be addressed center around the need for the Bureau to decide if limits should be set which regulate off-highway vehicle use, what they should be, and how to effectively enforce these limits. Additionally, what educational tools should be employed to reduce impacts from recreational uses of public lands?

3) Current Conditions:

The entire watershed area is allotted to some form of livestock grazing use during various periods of the year and is also utilized for wildlife grazing use in its entirety (although in most cases, significant wildlife use is seasonal.) Additionally, grazing use from wild horse herds occurs throughout the western half of the watershed area, within and immediately surrounding the Adobe Town HMA. Impacts to vegetation from grazing can, therefore, be expected to occur to measurable extents throughout the analysis area.

Quantifiable data about current vegetation conditions, health, and trends throughout the watershed varies as to availability, content, and quality. Upland monitoring information is available for varied grazing allotments and sub-basins within the watershed in the form of photo-points, aerial and basal cover transects, utilization studies, shrub belt density transects, and other, more species and/or impact-specific studies. Studies vary by amount, type, and content throughout the watershed in relation to the relative priority of the area/allotment, the level of management that was or is implemented, and/or the urgency of determining specific impacts. In the past, monitoring efforts focused on the collection of utilization information (what animals do to the plant), rather than on trend information (what the plant response is to animal use).

Vegetation and forage inventories of the watershed area have occurred periodically during the relatively recent past, the last of which, the Soil Vegetation Inventory Method (SVIM) occurred during the early 1980s. Data from this one-time inventory suggested that rangeland health conditions throughout the watershed fell into the acceptable range, mostly rated as "good" condition, but including "excellent" and "fair" condition rangelands. To a far lesser degree, isolated incidences of varied vegetation types were categorized as "poor" condition or unsuitable for livestock grazing (such as badlands and/or igneous outcrop types.) It should be noted, however, that these inventories and associated conditional assessments were one-time snapshots of the vegetation communities and did not and/or have not been altered or updated to take into account trends in ecological vegetation conditions. They also tended to undervalue shrub communities, resulting in mule deer habitat rated as fair, which should have been found to be good to excellent.

In general, varied livestock uses have resulted in assorted impacts to vegetation throughout the watershed. In many grazing allotments, summer grazing by cattle is the best-suited use by domestic livestock due to environmental, topographical, and climatic limitations, and vegetation is impacted (to various extents) during its growing period. This type of use also tends to primarily impact the herbaceous component of the vegetation community, except where young, available, palatable shrub seedlings are abundant. Where winter use is made by nomadic bands of sheep, the vegetation is impacted during dormancy, and the species that are impacted shift towards a mixture of shrubs and available herbaceous material. Where bands of wild horses are concentrated, their grazing impacts the vegetation throughout the year, removing vegetation prior to, during, and after peak growth periods. Wildlife use in the watershed, usually seasonal, tends to impact different components of the vegetation communities than does domestic livestock use. Mule deer use concentrates primarily on shrub or "browse" species and is most pronounced on winter ranges where the animals concentrate for extended periods. Elk use impacts both the herbaceous and browse components of the communities, usually at higher elevations throughout the year (dependent on the severity of winter weather). Pronghorn use impacts tend to be most noticeable in the lower elevation sagebrush and saltbush steppe, where they may be extremely concentrated during the winter, but more nomadic than other species (somewhat mitigating their impacts.) These differences in impacts tend to affect vegetation communities as species are favored or shunned in various management/use scenarios, leading to shifts in overall community make-up. Vegetative traits such as species abundance, vigor, diversity, and age/structure classes are all affected. These trends occur in addition to those which are influenced as a function of natural conditions (e.g., wetter to dryer sites, slope, aspect, soil depth, and material).

In many cases (dependent on the specific situation), best management practices for livestock grazing have been implemented on a case-by-case basis throughout the majority of the watershed. In some cases, multiple practices and improvements were necessary to maintain or improve overall vegetative health, and in others, only minor adjustments to grazing management have been or are required. Direct changes to grazing timeframes, including adjustments to duration, intensity, and season of use, have been implemented to remove constant, repetitive pressure on key forage communities during the heart of their growth period. Rotational grazing schedules that include deferment and recovery periods allow for preferred vegetation species to concentrate energy reserves towards vegetative growth. Upland water developments, including small stockponds and reservoirs, water wells, spring developments, and pipeline systems have led to better overall distribution of livestock use and facilitate grazing rotations and pasture systems. Fencing has been implemented to control livestock movement, allowing rotational grazing systems, and better distributing livestock use. Finally, vegetation treatments have been applied to limited areas within the watershed in order to introduce, or in some cases accelerate, the rate at which vegetation communities evolve and develop towards different seral stages. Very seldom (if ever) are vegetation treatment projects initiated with the objective of *converting* vegetation permanently to another type, but instead are intended to set the existing community back to an earlier seral stage and stratify the overall age class and structural variation (picture 53-1). Treatment of (mostly) shrub stands can also be used to improve livestock distribution, diversify shrub age classes and structure, and increase forage quality and herbaceous content (through the removal of competition for nutrients and moisture) (pictures 53-2, 53-3). Overall, livestock management throughout the watershed has been improved through the use of rangeland improvements and more intensive management without resorting to grazing exclusion, complete rest, or reducing permitted use.

At the higher elevations within the watershed, specifically the upper Muddy Creek and Savery Creek watersheds, livestock grazing occurs primarily as managed, summer/fall cattle use, with a small amount of seasonal sheep use thrown into isolated areas. Wildlife grazing occurs primarily as spring/summer/fall use, although much of the area is considered extremely important as transitional range for migrating big game. During milder years, the higher elevation may be used by wildlife well into or through the winters, primarily by herds of elk. In the majority of the grazing allotments within these areas, BMPs are in place to one extent or another, which mitigate negative grazing impacts and accentuate the positives. In many cases, grazing is rotated between pastures or use areas in order to lower the pressure placed upon desirable herbaceous forage species. Where these grazing management practices are employed, bunch grasses are abundant between shrubs, and herbaceous forage quality, including diversity, vigor, and density, is considered to be good to excellent. Utilization of upland forage vegetation tends to only become heavy or severe immediately around or adjacent to water developments or natural water sites. Examples of this can be found in the Loco Creek, Grizzly, and Beaver Dams allotments, which have all experienced some form of rotational grazing, upland water development, pasture fencing, and/or vegetation treatments. Conversely, pastures or allotments in which season-long livestock use takes place during the summer exhibit symptoms of degraded upland vegetation conditions to varying extents. One example is the Cherokee allotment, which has received spring sheep use and season-long cattle use on a continuing basis and where desirable upland bunchgrasses, although still present, are found mostly where they are not available to grazing animals, such as within or under shrubs. Most of the higher elevations in the allotment do not exhibit high amounts of invader species, but contain high percentages of less desirable and/or palatable increaser grasses and forbs such as western wheatgrass and Kentucky bluegrass. Browse species at higher elevations tend to be utilized through their growth period by (mostly) big game wildlife species, primarily mule deer and elk, but the use is dispersed to the point that specific instances of over-utilization (characterized by shrubs with a hedged appearance, and upon closer examination, vegetation removed far past the woody portion of previous year's growth) are rare on upland species.

Where portions of sub-basins at the higher elevations have been treated with prescribed burns, monitoring has shown that (with managed post-treatment use) the overall health of herbaceous vegetation is higher, with higher plant densities and increased species and cover diversity. Because most treatments are conducted to obtain a mosaic pattern, shrub age classes are diversified between older, mature-to-decadent shrub stands interspersed within and around areas set back to an early seral stage, which include many juvenile to young plants (picture 54-1 thru 54-3). Examples of these mixed vegetation communities, achieved through the recent application of treatments, include portions of the Morgan-Boyer allotment and uplands surrounding Loco Creek, which were treated during various periods of the last decade. Another specific example of a relatively large-scale vegetation treatment is the Sand Hills area that burned in wildfires in 1990 and 1993 (picture 54-4). Previously-dominated by extremely heavy, continuous stands of mature to decadent mountain shrubs, the fire set a large portion of the area back to early seral stage. Through the interim, vegetation within the burned area has shifted and developed, dominated at this point by bunchgrasses, but continually supplanted by juvenile, developing stands of silver sagebrush, snowberry, chokecherry, and serviceberry. Through the majority of these sub-basins, intentional treatments or natural events have been precluded or suppressed prior to gaining significant acreage, and the sagebrush and mixed sagebrush/mountain shrub stands contain plants of a uniform age and structural class, in almost all cases ranging from older-mature to decadent with a large proportion of dead individual plants. Although aerial canopy cover from shrubs can be quite high, the nutritional value and production drops, and overall ground cover percentages remain low and continue to decline over time as the understory is shaded by the larger shrubs and out-competed for nutrients and water. These areas exhibit lower species diversity and lower herbaceous cover, production, and nutritional value for livestock and wildlife forage.

The lack of treatments and aggressive suppression of all natural fire within these sub-basins has also affected the health of aspen stands by allowing them to over-mature and/or become decadent, diseased, and increased encroachment of understory shrubs and coniferous vegetation (fir and pine at the highest elevations, juniper at lower sites) within the stands (picture 54-5). Bleeding rust is present in most stands, primarily affecting larger trees, but spreads through the root systems to younger trees in the same clone (picture 54-6). Removing these larger, diseased trees can prevent the bleeding rust from spreading to young trees. It is estimated that less than half of the aspen stands that were present during the early half of the 20th century continue to exist today. As the older trees die or fall to wind events, they are not replaced by juveniles or suckers, and eventually, the stand dies or is reduced to a few remnants, dominated by big sagebrush, serviceberry, or other mountain shrubs. Of course, historical season-long livestock grazing has concentrated use on the seedlings in the past, but relatively recent implementation of rotational use and other upland grazing management tools currently mitigates these impacts, leaving a lack of stand replacement events as the missing element to enhanced aspen health. Prescribed burns have been planned and implemented to restore aspen health by stimulating sucker regeneration and removing other plant species that compete with aspen. Sites in the Beaver Dams and Hartt Creek allotments, burned in 1992 and 1996, show good vegetative response with light browsing use (picture 54-7). However, conditions required to burn shrub-lands, the most common type of vegetation treated, are often not hot enough to burn through aspen stands within the burn perimeter.

As elevation is lost in the watershed, the sub-basins, including the Barrel Springs Draw area, Lower Muddy Creek, and portions which drain directly into the Little Snake River, continue to be utilized for spring/summer/fall cattle grazing and are also grazed seasonally by bands of sheep, mostly in the spring and fall in higher (eastern) portions and during portions of the winter at lower locations. Wildlife use consists of yearlong habitat utilized by resident populations (predominantly mule deer and pronghorn antelope) and areas of winter range (primarily the area from the Dad junipers south to Baggs and along the Wyoming/Colorado border east and west of Baggs), which fill rapidly during late fall and early winter with migratory herds of deer and elk dropping below deep snow levels. Although the majority of the Adobe Town HMA is located at lower elevations west of these areas, wild horses inhabit portions of the area throughout the year (primarily in the portion of the HMA along the Flat Top Mountains and Red Creek and within allotments surrounding the HMA in this area, where unauthorized horse bands remain). Where they occur, bands of horses utilize vegetation in somewhat of a nomadic nature, although they remain tied to limited water sources.

As at higher elevations, impacts to vegetation vary dependent on implementation of BMPs and to what degree management practices have been implemented. Where long-duration, summer season grazing occurs as the primary livestock impact, desirable bunchgrasses have retreated to areas where they are unavailable to grazers and have been largely replaced in open areas between shrubs by increaser species such as western wheatgrass, annual forbs, and prickly-pear cactus. This is particularly evident along Muddy Creek at the confluences of lower Cherokee and Wild Cow Creeks and below Wild Horse Butte within the Cherokee allotment. Conversely, positive shifts in vegetation health conditions can be seen in even a relatively short timeframe when BMPs are emplaced, as evidenced by recent management changes implemented in the South Barrel allotment. In this area, the saltbush steppe flats surrounding South Barrel Springs Draw are steadily showing an increase in bunchgrass species such as Indian ricegrass and becoming more densely revegetated by a preponderance of squirreltail and Nuttall's saltbush where bare ground previously dominated (picture 55-1). These changes have been monitored after initiating a rotation of spring grazing use between two pastures where previously, only season-long grazing occurred throughout the allotment.

As vegetation at these elevations is usually available and relatively snow-free in all but the most severe winters, it is continuously used by wintering and/or migrating wildlife as transitional or crucial winter range. The area between the Dad junipers and Baggs, and along the Wyoming Colorado state line between Horse Mountain on the east and Poison Basin/Sand Creek to the west, provides the majority of winter forage and habitat for mule deer. Because vegetation communities in this area are used throughout the year by wildlife, and become heavily-used by concentrated populations during most, if not all, winter months, the preferred browse species are not only comprised of even-aged and structured, mature-to-decadent shrub stands, but are also severely impacted by season-long, intensive browsing, year after year. Specifically, severe hedging can be observed on Wyoming big sagebrush, antelope bitterbrush, and mountain mahogany almost anywhere within the Dad junipers, the Reader Cemetery area, and throughout the Poison Basin/Poison Buttes areas during spring months after the majority of animals have begun to migrate to higher summer habitat. Closer examination of hedged shrubs will, in many cases, reveal splintered woody material up to and above ¼-inch diameter, indicating that not only the current year's growth has been utilized, but in many cases, that of the year before also. Mature to decadent shrubs continue to dominate these areas, with little to no evidence of regeneration in the understory. In portions of the winter range where the vegetation is dominated by a juniper overstory, there is little recent evidence of use or "highlining" individual juniper trees, most likely due to the relative mildness of the recent winters (picture 55-2). In some areas, however, highlined juniper trees are common, most likely utilized during harsh winters during the last half of the 1900s. The area north of Poison Basin and over the northernmost escarpments of the Flat Top Mountains tends to receive snow, which precludes most wildlife use through the winter, but as the country opens up to the north, large numbers of pronghorn utilize the vegetation throughout the summer and winter months. Although high levels of grazing use from pronghorn can harm shrubs such as saltbush and sagebrush during the winter if animals are concentrated in a limited area for a long time period, it does not appear at this point that extreme impacts are occurring to vegetation from wintering antelope.

Similar to higher elevation shrub stands, vegetation within the mule deer and elk winter habitat zone has been largely untreated and natural treatment events have been aggressively suppressed before large acreages can be burned. As with higher elevation vegetation, this has allowed monotypic shrub stands to be dominated by mature-to-decadent, even-age classes of shrubs and/or juniper woodlands (picture 55-3). Overall vegetative productivity is lower than could be realized, and nutritional value of many of the plants is lacking compared to potential. The understories exhibit low density, vigor, and diversity of herbaceous material, and relatively high amounts of bare ground between plants. In most cases, the understory within juniper woodlands exhibits very low vegetative productivity and diversity, mostly dominated by bare ground with scattered monotypic shrubs and isolated bunchgrasses. At this point, many of the shrub stands within the area are treatable, given a reasonably wide array of application prescriptions and/or methods. Many of the juniper woodlands, however, are near or have progressed to the point that understory vegetation is suppressed and noncontinuous, precluding treatment by prescribed burning in all but an (unacceptable) crown-fire scenario. Vegetation north of Baggs and west of Wyoming Highway 789 within the Barrel Springs drainage generally exhibits high vigor, plant density, and diversity where BMPs have been initiated. Some of the heavier stands of basin big sagebrush located within draws and swales, however, exhibit high levels of density in the shrubs themselves and suppressed understory herbaceous vegetation health.

Within the lowest and westernmost elevations of the watershed, impacts to vegetation occur mainly in the form of dual livestock use, consisting of summer (and in limited cases winter) cattle use, and/or late fall and winter sheep grazing. The Adobe Town HMA covers a large portion of this area, and significant use of vegetation also occurs outside and adjacent to the HMA from wild horse bands that inhabit these allotments on a yearlong basis. The summer cattle grazing is managed, for the most part, in a manner that allows either rotational growing season deferment, rest, or recovery periods or a combination thereof. This has led to increased occurrence and availability of more palatable and desirable bunchgrass species and a general increase in overall vegetative health. Winter sheep use (and limited winter cattle grazing) occurs during the dormant season, when energy is stored beneath ground, and so poses few negative impacts to the plant(s) as long as pressure is not reintroduced during early spring green-up or maintained on limited locations for long periods of time, removing most to all of the above ground biomass. The nomadic, herded nature of sheep use tends to preclude intensive, long-duration pressure on specific vegetation, although bedding grounds used for several consecutive years can be damaging to vegetation without periods (seasonally or even yearly) of recovery. Another vegetation type that receives more attention from herded sheep bands is the saltbush steppe, which is highly desirable to sheep due to high nutritional value prior to entering winter use periods or prior to introducing bucks into the band. Repeated, consecutive grazing use on specific areas of saltbush vegetation can lead to very low vigor and productivity, and inter-shrub bunchgrasses become less numerous and interspersed with more bare ground. Where management such as rotational summer use, fencing, and upland water development has been introduced and/or historically implemented, healthy, vigorous, and diverse understory grasses and forbs are present, and bare ground is minimized between plants. Although increaser species are present throughout the area, most are proportional to more desirable bunchgrass, forb, and shrub species. Within managed grazing allotments outside of the Adobe Town HMA, desirable or key forage species are, in most cases, more numerous, available to grazing, and evenly-spaced between shrubs than will be found in pastures/allotments where uncontrolled, season-long grazing occurs.

Within the Adobe Town HMA, wild horses become a third user of the vegetative resource in addition to livestock and wildlife. Actions and tools which are specified for the management of wild horses are limited to the use of gathers and removals of portions of the horse population on a continuing basis in order to sustain the population at AML. The AML is determined to be a population level that can be supported by the available forage in conjunction with amounts removed by other uses, including livestock and wildlife. During the last several years, even this management tool has been largely removed (due to logistical, legal, and/or political constraints), and the vegetative resource within the affected allotments is showing the negative effects of supplying grazing forage to bands of horses which number around 2½ times what is deemed appropriate. Similar to unmanaged cattle use, wild horse distribution is uneven and concentrated around limited water sources (picture 56-1). It takes place throughout the year, and more importantly, throughout the growing season, regulated only by availability of forage and water sources. As population levels have risen dramatically in the last several years, impacts to forage, particularly bunchgrasses and perennial forbs on sites with higher productivity, have risen. Utilization has been observed at high to extreme levels in areas where little use was made previously due to the relatively remote location and longer distance to water sources. Vegetation surrounding limited water sources, which experienced high utilization levels even prior to the current wild horse population boom, is grazed extremely heavily by a combination of species and periods of use. Some of the effects observed within the HMA include a lack of perennial understory bunchgrasses and increased bare ground, an abundance of annual forbs, and lower vigor, production, and density of grasses and shrubs within the saltbush steppe community, as well as in draws dominated by the sagebrush-grass vegetation type. On many Nuttalls’ saltbush flats, it is evident that heavy grazing use has affected the individual saltbush plants to the point that some plants are completely incapable of regeneration, and the remainder of the stand will require a significant period free from grazing pressure to recover to pre-grazed levels. Due to the combined grazing effects from domestic livestock and unrestricted wild horse use, it is difficult to determine which use most impacts the vegetation.

Vegetation in this area is used seasonally to varying degrees. Summer use by pronghorn antelope occurs throughout the area, primarily in the lower elevation sagebrush-grasslands and scattered throughout the Adobe Town badlands and Kinney Rim country. Winter pronghorn use usually occurs south of the Wyoming/Colorado line, causing little impact to vegetation within the subject area. Mule deer use during the spring, summer, and fall occurs primarily in the mixed sagebrush/mountain shrub-grasslands at higher elevations, primarily around and over the Flat Tops, although scattered deer utilize the broken country from Willow Creek to the top of Kinney Rim and the mixed sagebrush/mountain shrub/juniper woodlands of Powder Rim. Observations of vegetation within this winter range indicate that summer use by mule deer has little to no effect on key species such as mountain mahogany, serviceberry, Wyoming big sagebrush, and bitterbrush. Vegetation utilized during the winter months through this area can truly be considered “crucial” winter range, as it appears that it is heavily utilized only during more severe winters, as large numbers of deer are pushed from the higher transitional and winter range outside of Baggs. Although always used by deer in the winter, recent easy winters have not concentrated large numbers in the area, as evidenced by actual observation of animal numbers, as well as lower utilization levels on key shrub species on Powder Rim west of Sand Creek. Important species including bitterbrush, serviceberry, and mountain mahogany display relatively low to moderate levels of browsing in the area covering Powder Mountain east to Anthill Knob, a key area within the winter range where deer seem to converge annually, regardless of weather conditions. Key mountain shrubs in this area appear to be in the best condition of any on the entire Baggs mule deer winter range (from Dad to Baggs and between Horse Mountain and Powder Mountain along the Wyoming/Colorado state line.) Although these shrub stands appear to be in comparably good health, there is evidence that many stands are reaching, or have reached, a stage of older-mature to decadent, as evidenced by a large percentage of dead plants and/or dead portions of live shrubs. Additionally, many shrub stands are experiencing various levels of evergreen encroachment, as older stands of junipers adjacent to them spread outward, out-competing and converting portions of the stands. Although individual junipers show little evidence of browsing use or highlining, the understory vegetation is sparse within dense stands, and species diversity is significantly lower than can be observed adjacent to or within more open stands. Vegetation used by elk is primarily concentrated to a combination of grasses, dried forbs, and limited browse species utilized during the winter months. Although use occurs during the summer months, the limited number of animals and their highly wandering nature make it relatively immaterial in comparison to summer cattle and especially wild horse use (both of which exhibit high dietary overlap with elk). As with mule deer, elk populations and use levels rise dramatically during the winter months when migratory animals from as far as Steamboat Lake in Colorado increase the population on Powder Rim two to threefold. Even at these higher levels, the population does not appear to adversely affect the vegetation on Powder Rim, most likely because the use occurs on vegetation in dormancy, and is not revisited on individual plants during the same season. Summer utilization levels (by cattle, wild horses, and/or summer elk populations) of forage species used by elk has not appeared to adversely affect winter range forage amounts, apparently leaving enough standing forage to sustain wintering herds. Winter forage use by elk can be found throughout Powder Rim and occurs in rougher country avoided by cattle during the summer, but is also concentrated within limited areas previously treated by wildfire. Photo point documentation of the vegetation in these wildfire areas reveals that, although shrub regeneration is limited, forage production continues to be very good.

As in the other portions of the watershed, vegetation treatment has been limited and wildfires have been aggressively suppressed throughout this area, to an even higher extent than has been experienced at higher elevations. During the last ten to fifteen years, only two significant wildfire events have occurred on Powder Rim, treating less than 1,500 total acres of mixed sagebrush, mountain shrubs, and juniper (picture 57-2). Both wildfires were suppressed prior to gaining any significant size (the first was monitored until it reached between 800 and 1,000 acres, after which it was put out, and the second received full suppression action due to its proximity to the first event.) There have been no significant vegetation treatments undertaken in the area during the recent timeframe, although several are planned for the next few years. The last major vegetation treatment accomplished on the rim was a chemical sagebrush treatment in Pasture A of the Powder Rim allotment, in which sagebrush has revegetated to levels at or above those existing prior to treatment. Both wildfire events occurred during extreme environmental and climatic conditions (hot, dry weather), causing removal of mountain shrub species which remain absent to this time, probably due to the intensity of burn conditions scarifying growth nodules and/or actually completely killing moderately-sprouting shrub species. Although these events have probably not completely "converted" the vegetation community in the long-term from sagebrush/mountain shrubs to grassland, succession towards mid-to-late level seral stages appears to be slower than would be expected with a planned treatment implemented under ideal prescription conditions. Over the rest of this habitat, as well as the remainder of this portion of the watershed, the lack of periodic stand-replacement type events has allowed sagebrush and mountain shrub species to reach a level of over-maturity and decadence, and juniper woodland communities threaten to encroach on and overwhelm portions of the shrub lands. In many cases, understory grasses and forbs (and in the case of juniper woodlands, the understory shrubs as well) have been suppressed by the large, mature shrubs; resulting in lower vigor, density, and diversity of these species. Dense, over-mature/decadent sagebrush grasslands have also become incapable of reaching their potential for forage production and/or nutritional value. The Sand Creek and Shell Creek watersheds, which encompass almost all of the western two-thirds of this area, have received the least amount of natural and intentional vegetation treatments of anywhere in the watershed. Although it is not practical to treat many of the sagebrush-grass and saltbush shrub steppe communities in this area, the lower elevation flats and rolling hills contain many dense stands of basin big sagebrush, which are obviously mature to decadent. Many of these sites have developed on deeper soils, allowing the sagebrush to grow to extreme heights and exhibit exceedingly high aerial canopy cover. Ground cover, plant density, species diversity, and overall production and vigor under these stands has plummeted. The low amounts of introduced treatments in these types of systems has led to a preponderance of heavy, mature basin big sagebrush stands scattered throughout the area where soils allow their development.

Overall, vegetation in the Little Snake River watershed can be considered to be in good health relative to the seral stage to which it has developed. Desirable species (including herbaceous and browse species important for livestock and wildlife forage, as well as those important for ground cover) are present at worst, usually found in locations where they are less available or vulnerable to grazing animals, and are prevalent at best, found interspersed throughout the various plant communities, with high vigor and density. Although less desirable increaser species are present in varying degrees throughout the watershed, in most cases, their presence does not indicate poor health or nonfunctional vegetation communities. The majority of the watershed has undergone the implementation of various BMPs, to some extent, which favor more desirable forage species over increasers, and the results can be readily observed in the form of more plentiful bunchgrasses, higher ground cover, greater plant diversity, and higher vigor and nutritional value of individual plants. Throughout various portions of the watershed, invader and weed species can be found, but these populations exist at relatively low levels and have not converted entire communities. Additionally, implementation of various BMPs, as well as application of various control methods, are being and can be utilized to manage, if not eliminate, many of these small-scale infestations. All of these observations are indications of properly functioning upland vegetation communities.

The nonfunctional or at-risk aspect of upland vegetation communities in the watershed that is evident centers on the late seral stage of development that the vast majority of shrub stands and woodlands have reached without disturbance or stratification. This can be observed as the predominance of even-aged and structural classes of overstory shrub stands that have reached a level of mature to decadent. As noted previously, in every portion of the watershed, the predominant overstory shrub or woodland community can be considered monotypic, with few, if any, instances of early or mid-seral shrub communities interspersed within the landscape. Although a *portion* of any vegetation community should be expected to exist in a mature to decadent (or late seral) stage in order to be considered healthy and properly functional, there also must be a mixture of early to mid seral components mixed throughout, on a community or landscape scale. Unfortunately, this is not the case within the majority of the Little Snake River watershed, where late seral communities dominate. As dominant shrub and/or woodland vegetation continues to age and decline, individual plants or portions of them die and are not replaced by juvenile seedlings or tillers, and understory vegetation decrease in density, abundance, and diversity. Production and vigor of understory grasses and forbs decreases, and less vegetation remains after growth, leaving less litter above and below ground, supporting less overall nutrient cycling. Less desirable species such as coniferous trees in aspen stands and junipers in sagebrush and mountain shrub stands continue to encroach and outcompete the more desirable components. Aspects of the vegetation, including values for ground cover, big game habitat, and livestock forage, decrease, putting the entire community into an "at risk" category. Additionally, the communities can be considered at risk due to the homogeneous and continuous nature of these dense, mature shrub stands, because the potential exists to lose large blocks of vegetation to catastrophic wildfire events, as few vegetation transition-type fuel breaks are located (or placed) within landscape vegetation communities.

4) Reference Conditions:

Generally, historical influences on vegetation in the watershed were similar to those that shape the communities today. Environmental conditions, including soil conditions, climate, topography, and elevation determined the general composition, location, and interaction of vegetation communities, which were and are influenced by additional, less constant factors. Due to low human population levels in this remote area, influences by native peoples were probably relatively minor and/or secondary in nature (e.g., the influence that hunting cultures had on seasonal use of certain areas by grazing game animals). Prior to settlement of the area by Euro-Americans, additional factors that probably had the most influence on vegetation conditions would have been limited to grazing impacts from native ungulates and catastrophic stand-replacement type natural events such as wildfires. The combination of varied, wandering use patterns and the random occurrence of wildfire, which removed vegetation in a haphazard pattern, probably led to a diversified vegetation pattern that was thoroughly stratified in age class and seral stage, as well as vertical and horizontal structure.

The early descriptions of the Little Snake River watershed tend to suggest the presence of grazing ungulates throughout, including seasonally migratory species such as bison, pronghorn, mule deer (called black-tailed deer in many early journals), and elk. Additionally, bighorn sheep and grizzly bears could be found, even at lower elevations. Although wildlife population levels prior to the adoption of structured harvest strategies and conservation measures in the first half of the 1900s can only be estimated, most of the species remain (excepting bison, bighorn sheep, and the large predators including wolves and grizzly bears). Topographic and climatic factors would have dictated seasonal use areas and migration patterns then, much as they do today. Additionally, Native American cultural relics such as tools and/or petroglyphs survive as evidence that they did at least seasonally inhabit some of the more remote areas of the watershed, such as the Adobe Town rims and the Powder Rim/Shell Creek country, following seasonal movements of the big game species they hunted for their livelihoods. Although, as indicated by various accounts, limited, isolated groups or herds of bison could be found through the watershed on a resident basis, the area was probably also used by extremely large herds of the animals in more of a cyclic nature as their wanderings covered an extremely vast amount of country. In any case, it can be reasonably inferred that vegetation in various portions of the watershed was utilized by grazing ungulates throughout the year, which rotated from area to area dependent on climatic conditions much as happens today with migratory big game herds. What is not clear, however, is if high amounts of grazing use were applied to various portions of the watershed by large, concentrated herds of animals on a cyclical or continuing basis, and if so, what the intensity and/or repetition of use might be.

As mentioned previously, Native Americans inhabited various portions of the watershed on an at least seasonal basis. Although it is not certain to what level they made use of horses, it can be inferred that any herds that traveled with the bands made use of the forage in a nomadic nature, resulting in relatively low, seasonal impacts. Wild horse herds in the area largely appeared after the initial Euro-American settlement during the late 1800s, and grew as the permanent human agricultural presence increased, and domestic stock escaped or were grazed “free-range” and incorporated into passing bands. Until passage of the Wild Free-Roaming Horse and Burro Act in 1971, wild or feral horses inhabited almost all of the Little Snake River watershed north of the state line, including the area east of Wyoming Highway 789 and the Upper Muddy Creek basin. Until passage of the Act, they were managed only to the extent of what they were worth. Free-ranging horse populations were controlled by gathers and/or culling by private individuals, and there was no real data that defined populations and/or resource impacts by the animals. After management was implemented, horses were removed from the portion of the watershed east of Highway 789, and government gathers were utilized to remove excess animals from the rangelands within management units. In other words, historical impacts to the vegetation resource within the Little Snake River watershed from wild, free-ranging horses were largely unknown prior to the management act. Actions taken towards the animals to influence their impacts would have been haphazard, uncoordinated, and the results completely indecipherable. It can be inferred, however, that impacts would have been similar to those at present within HMAs to the extent that seasonality, duration, and intensity of use on vegetation were and are governed totally by the animals themselves, subject only to climatic and topographical influences. The portion of the watershed east of Highway 789 no longer experiences any impact from wild horse grazing.

Historical documentation, mostly in the form of journals, descriptions, and writings of explorers who traversed the area in the mid-1800s, compared and contrasted with additional accounts made in the same area during the same general time frame, can paint a picture of the overall landscape. Although generally vague to the point that overall vegetation, range, and/or habitat communities and sites cannot be delineated, they do provide a fairly recognizable overview of the area between Rawlins, Baggs, Bitter Creek, and the Wyoming/Colorado state line.

Overall, the general historical vegetation description of the Muddy Creek watershed appears to closely correspond to the existing communities. Although the popular perception of western rangelands prior to Euro-American settlement is that of rolling grasslands and foothills bounded by timbered mountains, which have only relatively recently (in the last century and a half) been turned to shrub-dominated steppe type communities due to grass use by livestock, accounts offer a different view, indicating shrub dominance in this area through the mid-and-late-1800s. John C. Fremont's party viewed the general area as early as 1845 and indicated that in the area west of Overland Crossing of the Platte River (east of the Muddy Creek watershed), there was "nothing to be seen but artemisia bushes." The description of the general area west of present-day Rawlins was that of "a continued and dense field of artemisia, which now entirely covered the country in such a luxuriant growth that it was difficult that laborious for a man on foot to force his way through, and nearly impracticable for our light carriages." When army topographer Howard Stansbury traveled from Bitter Creek to Muddy Creek in fall of 1850, covering the northwest portion of the watershed including the Upper Barrel Springs Draw area, he discussed how grass was very scarce, barely enough to feed the mules, and that sagebrush furnished fuel. Around 15 miles south of present-day Wamsutter, he recorded thin grass, small sage, greasewood, and in the sandy places, small cacti. The Bryan Wagon Road Survey commented on the area during a July 1858 trip. About 15 miles south of Red Desert (in the area of Upper North Barrel Springs Draw), they described white clay bluffs sparsely covered with cedars, which lay to the south, bunch grasses scattered over the country near camp sufficient for the animals, and sage used as fuel. F.V. Hayden traveled through the area in September, 1868, performing geological exploration and wrote; "This vast barren sage plain stretches far westward [from Pass Creek] to Bitter Creek and Green River, with very little grass or water for the traveler . . . ."

Stansbury's party, on reaching Muddy Creek, around 20 miles south of present-day Creston Junction, observed some junipers on the surrounding buttes, the first trees since leaving the Green River, and noted that grass was scanty. As they moved to the east (towards the headwaters of Muddy Creek and Bridger Pass), the hills closed in, forming a narrow valley where there were many deep-cut channels with nearly perpendicular sides. A few aspen were noted in the bottom, with many sagebrush, some eight feet high. When the Bryan Wagon Road Survey crossed from the Sage Creek basin to the headwaters of Muddy Creek in 1856, they noted, "The thick growth of sage was very much in our way, obstructing the passage of wagons, and fatiguing men and animals very much." They also noted that grass was scarce and an isolated growth of pines in a nearby valley. They also observed that near the head of Muddy Creek, the "country rough from gullies and sagebrushes . . . . Sage for fuel, besides willows from the bank of the creek." There was bunch grass mingled with the sage near the mouth of Littlefield Creek, but after another mile, grass became scarce, and beyond this point, any grass of consequence disappeared, and sage was the only fuel to be had. When F.V. Hayden passed through during the fall of 1870, he noted an improvement in vegetation as he approached Bridger Pass from the west and that groves of aspen and pine were seen.

Early exploration of the higher elevation country, including the Savery and Sandstone Creek area, occurred during the summer of 1844, by John C. Fremont, the army topographer. The expedition observed aspen and willow thickets and plenty of game, including buffalo, elk, antelope, bighorn sheep, and deer, and noted, "The country here appeared more variously stocked with game than any part of the Rocky mountains we had visited; and its abundance is owing to the excellent pasturage, and its dangerous character as a war ground." About the Elk Head (Little Snake) River in the Baggs area, they noted, "The characteristic plant along the river is F. vermicularis [greasewood], which generally covers the bottoms; mingled with this, are saline shrubs and artemisia… The country on either side was sandy and poor, scantily wooded with cedars, but the river bottoms afforded good pasture."

Finally, a party including W.A. Richards surveyed the southern Wyoming border during 1873, and, in addition to feeding the party with a steady stream of wild game which was plentiful throughout the Sierra Madre mountain range, noted that the terrain and vegetative cover turned fairly desolate west of the Baggs area. Again, the dominant vegetation was sagebrush, and as they moved west, they "camped on [a] dry creek [Cherokee Creek] . . . . The country here perfectly worthless. Nothing but sagebrush and greasewood. Soil sandy clay."

Although further vegetative descriptions of the area during settlement (late 1800s through the first half of the 20th century) are scattered, photographs taken throughout the area, and in particular along the Overland Trail and Rawlins to Baggs stage road, can be observed. Many of these photographs, although of various quality, indicate that shrub dominated communities were abundant, if not the norm, at least in the vicinity of the sites where photographs were taken.

If taken as a whole and compared to and against each other, these accounts tend to suggest that the majority of the upland vegetation in the Little Snake River watershed varied little from that which is noted today, dominated by heavy sagebrush and mountain shrubs with inclusions of aspen woodlands at higher elevations, dropping to juniper woodlands scattered over and within rolling sagebrush-grasslands and arid saltbush steppe communities, relatively low in production. One comment, from John C. Fremont's 1844 exploration, tends to suggest that upland spring/seep sites and corresponding riparian areas may have been more common. As they moved north from the Little Snake River up the Savery Creek drainage and north across the surrounding hills, "every hollow had a spring of running water, with good grass." While many hollows and draws in the Sierra Madre foothills do hold small seeps and occasionally run water, the declaration that "every hollow" contains such a water source would seem to be excessive at this juncture.

Historical or reference vegetation conditions in the Little Snake River watershed prior to extended human influence appear to mimic those found today; i.e. species composition and general distribution are probably very similar. The amount and distribution of various communities and their interspersion between others was varied from the present. Additionally, the seral stage of communities and age class structure at any given time was likely much more diverse. Influences on vegetation historically were mostly limited to "natural" events, primarily the grazing patterns of wild, free-roaming ungulate populations and the occurrence of stand-replacement events such as wildfire. In the ensuing period, the type of animals that exhibit the most influence on vegetation throughout the watershed has changed with the introduction of both managed and free-roaming seasonal livestock grazing, free-ranging wild horse populations within the HMAs, and migratory wildlife populations that are now manipulated by organized human harvest. In the last century, human influence has also led to the virtual eradication of large-scale, random, stand-replacement type vegetation treatments throughout the majority of the watershed and the manipulation and management of those that do occur.

5) Synthesis and Interpretation:

As described and discussed previously, upland vegetative species within the Little Snake River watershed are very similar at present to that which would have been encountered prior to settlement of the area. The principal changes are in the type of animals, which utilize the resource, and the amount of disturbance that is levied towards the vegetation from other human activities. Sagebrush and mixed sagebrush-mountain shrub grasslands and aspen and juniper woodlands continue to dominate the landscape throughout the watershed. The most obvious changes in vegetation on the landscape are evident where all or a portion of an existing community has been removed or "converted" to some other type. This can be observed along roads and trails in the landscape, which cut through and dissect large-scale community types; well pads or structures erected within the landscape; or agricultural conversion such as irrigated or dry-land farming where the native vegetation has been removed to make way for croplands (most commonly alfalfa or native grass hay land in various portions of the watershed). Less obvious are changes within vegetation communities that have occurred naturally as communities evolve or have gradually been altered through the addition, subtraction, or manipulation of additional influences (e.g., a shift in vegetation consumed as traditional livestock uses are supplanted by animals with different dietary preferences).

Shifts in vegetation communities from historical conditions are partially the result of use by grazing ungulates. Generally, grazing use throughout the watershed has placed pressure on developing vegetation through various portions of its seasonal life cycle. Late spring and early summer grazing by cattle, sheep, horses, and/or big game wildlife species places the majority of grazing pressure on growing herbaceous material. As the summer hot season progresses, cattle and horse use within the watershed continues to primarily remove grasses, while sheep (which are mostly absent from BLM-managed public lands in the watershed at this time) and wildlife use tends to shift towards browse species on uplands. Fall and winter use by cattle, horses, and wintering elk herds, although still focused on grasses, removes mostly dead and dormant material, and sheep, pronghorn, and winter mule deer use removes portions of the summer's growth mostly on shrub species mixed with dried and desiccated forbs. Shifts in composition that have occurred internally in various upland vegetation communities in the watershed (due to grazing pressure by ungulates) have been primarily driven by the following factors: continuous, repeated, and sustained grazing pressure on selected, preferred herbaceous species through their peak growth periods (primarily on cool-season bunchgrasses during late spring and early-to-mid-summer), and intense, concentrated, and sustained seasonal browse use on preferred shrub species (by wintering big game herds) in stands that have reached a high overall level of late-maturity to decadence.

Historically, the higher elevations within the watershed were grazed by a combination of summer cattle and transitional (spring and fall) and summer sheep use (picture 62-1). Lower elevations to the west were traditionally used as winter sheep grounds, with limited amounts of summer cattle grazing, usually in higher fringe areas. The summer, season-long grazing that occurred repeatedly during the last century has generally allowed more of an influence by increaser species within communities and tended to push more desirable decreasers to more unavailable locations (such as within shrubs and in rougher terrain). Availability and predominance by more desirable forage species is enhanced as distance is gained from water sources, and terrain becomes steeper. Winter use areas at lower elevations, where herded bands of sheep have been moved throughout the terrain in a nomadic fashion, tend to retain most of the desirable increaser forage species in a more available fashion, due to the timing and duration of use (dormant season and relatively-short periods of use which are not repeated during any one year.) Livestock grazing management changes have and can be implemented in order to mitigate the effects of growing season grazing pressure and include pasture or use area rotational systems that manipulate the duration, intensity, and timing of use to provide deferment and/or recovery periods for vegetation growth. Fencing and/or herding are used to control the livestock's activities during use periods, facilitating implementation of rotational systems, and upland water developments are designed to more evenly distribute levels of vegetation use throughout pastures and allotments, protect isolated riparian sites, and provide watering locations to dry pastures. Additionally, the predominant vegetation (typically shrubs) can be treated or removed, allowing increases in more productive herbaceous vegetation which creates higher amounts of forage, higher overall nutritional value, and can create useable forage in areas which were previously underutilized. These types of treatments are usually temporary in nature, and revert to pre-treatment conditions after the passage of various time frames, allowing other areas to be manipulated during the interim and creating a mosaic of vegetation types. During the last half of the 20th century, all of these practices have been implemented, to various extents; throughout the watershed where summer cattle grazing use occurs. Due to political and/or logistical limitations, vegetation treatments have been restricted in the watershed more than implementation of other BMPs. During the last 25 years, as many of the traditional winter sheep use areas have undergone conversions to summer cattle use allotments, additional BMPs have been implemented at lower elevations, where customarily, none were required. A limitation that is frequently encountered when winter sheep use areas are converted to cattle use is a lack of adequate control measures to manage the use. This can lead to trespass problems and additional or unauthorized use on the subject or adjoining allotments. Where vegetation in winter sheep use areas has or can be damaged due to special uses (e.g., traditional bedding grounds, areas where sheep have "yarded up" due to weather), future management would include avoidance by herded bands for an appropriate recovery period.

Where wild horse bands inhabit the watershed, the use of BMPs to control their effects on vegetation is limited. Within the Adobe Town HMA, the ability to manage horse impacts is limited to maintenance of the population to an AML of between 600 and 800 total animals, and outside of the HMA, the management of wild horse impacts should not be an issue, as there should be no animals in these allotments. Historically, population levels were controlled through the use of culling and gathers by private interests, which for the most part kept numbers at a level compatible with livestock use in the watershed. After passage of the Wild Free-Roaming Horse and Burro Act, the responsibility of maintaining horse populations was passed to the federal government. In the eastern portion of the Little Snake River watershed (east of Wyoming Highway 789), the BLM has fulfilled this obligation by removing horses, as called for under the management strategy. West of the highway, both inside and adjacent to the Adobe Town HMA, the BLM has fallen short of its responsibilities due to inadequate funding and/or political and logistical constraints. The number of horses inhabiting the Adobe Town HMA is in excess of 2000, and a significant number roam outside the HMA, where management strategies stipulate their absence. The management plan for the Adobe Town HMA makes the assumption that the desired AML will not lead to negative impacts to upland or riparian vegetation, even in the absence of BMPs, but quantifiable data has never been gathered to determine if this is the case (in the current analysis, wild horse numbers have been above desired AML since 1997.)

Wildlife impacts to vegetation, although applied across the watershed, tend to most directly impact preferred, desirable shrub species on transitional, winter-yearlong, and to a lesser extent truly "crucial" winter habitat for mule deer. Most intensive negative impacts can be observed on the mid-elevation transitional and wintering habitat, where large herds have settled in for the last several "easy" winters and removed large portions of the current and previous years' vegetative growth. Although herd numbers are at or near objective, the numbers of animals utilizing the habitat probably has less effect on the vegetation than does the overall age class uniformity and maturity of the stands. As the individual plants reach a stage of over-maturity and decadence, annual vegetative production decreases, and as the current and/or portions of the previous years' growth is removed, the plants become more and more hedged, further deteriorating overall stands. New, juvenile plants are removed quickly if they are available, due to the higher palatability and/or nutritional content, leading to an overall loss of productivity and further aging of the stand. Additionally, as stands age, rival vegetation surrounding the shrubs, such as junipers, tends to spread into and intermingle with the shrubs, out-competing them and shifting the overall community composition. Management changes that would focus on stratifying shrub stands and diversifying overall community composition, stand age and structural class, and habitat production would center on setting portions of the communities back to early seral stages, in staggered time frames. This would involve the application of treatments to remove portions of the existing vegetation in a mosaic pattern, allowing recolonization of new, juvenile shrub species, new and additional herbaceous species, and shifting the community composition immediately following conversion. Treatments can be designed in scope, coverage, seasonality, and implementation methods to achieve predetermined objectives and to allow medium to long-term community development towards habitat objectives. Treatments can also be planned and implemented so that total vegetation community conversion is not achieved or encouraged, allowing shrub stands to evolve towards pre-treatment conditions over an extended timeframe. In many areas considered "crucial" winter range in the watershed, shrub stands appear to be in better overall health, most likely due to more limited seasonal use, affecting less of the current year's growth, and very rarely extending into the previous year's production. These shrub stands, however, mimic those found at higher elevations in that they are composed of a monotype of even-aged, mature to decadent shrubs, which continue to age and lose productivity and vigor, and are increasingly encroached upon by less desirable juniper woodlands. Portions of these stands can be treated and set back in succession before reaching the point at which "stand replacement" type events are the only treatment option, whether planned or naturally occurring. They can also be treated while the opportunity is presented and before a hard winter pushes large numbers of wintering wildlife into these areas and severely impacts desirable shrub species.

Loss of vegetation that occurs due to the proliferation of roads and trails, although proportionally smaller than other impacts, tends to be more evident and can be equally severe on a small scale because all vegetation is totally removed along the entire area of impact. Even improved roads, if not adequately designed and/or drained, lead to vegetation loss/community conversion on adjoining lands through increased erosion/sedimentation immediately along the route and introduction of less desirable species from disturbance along the route. As noted in the watershed health section, there is a large need for further work on nearly all improved roads to reach an adequate level of improvement practices (gravelling, additional culverts, wing-ditching, water-bars) to minimize or eliminate overland flow alterations and vegetation species movement/colonization. Equipment used to sustain or improve highly traveled routes should be maintained in a weed-free status, as noxious weed infestations have arisen in areas of recent maintenance in various portions of the watershed. Recreational use of roads and trails, and particularly the pioneering of new trails by illegal off-highway driving is increasing dramatically, including problems stemming from hunting, joy-riding and (especially noted during the last few years) the increasing popularity of antler hunting in the late winter and spring. Greater availability of disposable wealth has led to greater availability of all terrain vehicles (particularly 4-wheelers) and pickup trucks, which have exacerbated this impact, particularly in areas with easy access and proximity to towns, but also at an alarming pace in remote portions of the watershed.

Reclamation standards, and their application (or lack thereof) directly affect the vegetation through the watershed by allowing or precluding an unoccupied niche, which less desirable increasers or invader species attempt to fill. Poor reclamation practices, found in various portions of the watershed, mostly on developed and/or capped well pads, lead to an increase in weedy species, mostly halogeton and cheatgrasses, which thrive and spread to surrounding rangelands. Good or even adequate vegetation reclamation, which can also be found throughout the watershed, most notably on pipeline routes, results in little unoccupied space for infestation, high forage production, and the proliferation of desirable introduced or annual species which tend to remain within the project's right-or-way area and only affect the surrounding rangeland in a limited manner.

6) Recommendations:

At the present, the review of upland vegetation conditions in the upper Colorado River watershed reveals generally good overall community health. Natural ecological and biological processes appear to be functioning adequately overall, although concerns about current, and especially near-future, functionality of certain community types remain. Specifically, the review group has determined that the majority of upland vegetation communities are properly functioning in relation to the seral stage to which they have evolved. Several specific communities, however, elicit concerns due to their uniformity of age and structural class, and the imminent onset of over-maturity to decadence throughout the majority of sagebrush stands, aspen stands, and juniper woodlands in the watershed and mountain shrub stands/mixed sagebrush/mountain shrub grasslands on winter-yearlong and transitional big game habitat.

Specifically, aspen stands throughout the watershed do not meet the standard for upland vegetation health due to decadence and decreasing occurrence and coverage of these stands. Although concentrated at the higher elevations, many of these stands are scattered through lower elevations in more isolated pockets, totaling around 14,000 acres of land within the watershed. The other vegetative community in the watershed that does not meet the standard for rangeland health is mountain shrub, sagebrush, and juniper plant communities located on mule deer crucial winter range between Horse Mountain and Poison Basin along the Wyoming/Colorado state line, and north from Baggs along Muddy Creek. These shrub communities cover approximately 40,000 acres within the watershed. Livestock grazing is a componet in the management scenario of these plant communities, but it is not the principle factor in non-attainment of this Standard.

In spite of these concerns, the diversity, vigor, productivity, and overall amount of upland vegetation within the watershed, as well as the cooperation exhibited by the majority of livestock permittees towards grazing management, suggest that no insurmountable vegetation health problems are evident on a significant scale in most vegetation communities. Due to the existing conditions and general vegetation community heath on uplands, the management responsibility by private industry, agricultural interests, and agencies which design and mitigate impacts to the vegetative resources from natural resource uses, and the generally small number of management issues that need to be dealt with, it is determined that the remainder of the Little Snake River watershed is meeting Standard #3 – Upland Plant Health. The following recommendations would expand upon the successes already achieved and help to meet desired resource conditions in the future.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. These practices utilize, but are not limited to, the control of season, duration, intensity, and distribution of livestock use to meet desired resource objectives for upland vegetation as well as riparian habitat. Specific dates or timing of use must be decided on a case-by-case basis specific to the management unit and/or site limitations. Methods that can be used to achieve resource conditions include, but are not limited to, livestock control by pasture fencing or herding, water developments, vegetation treatments, and/or the manipulation of livestock turn-out/removal dates.

Identify and correct problems with improved roads which affect vegetation community health and/or composition, including the implementation of mitigation and/or improvements to improved travel routes that will modify overland flow regimes and erosion/deposition patterns which influence the surrounding and adjacent vegetation communities. Pioneered and/or illegally located two-tracks or trails should be dealt with on a more location-specific basis, perhaps centered on prominent recreational/habitat type landforms (e.g., Powder Rim between Sand Creek and Powder Mountain, the Flat Tops, Willows/Sand Hills area, etc.) There is a need throughout the watershed to remove duplicate/redundant motorized vehicle travel routes, as well as unimproved routes creating vegetation or watershed-damaging disturbance, although the scale of such management should be dependent on the issues involved with the specific, identified management unit. Enforcement of travel regulations, including ticketing of illegal off-highway use and increasing reparations for violations should be implemented throughout the watershed. Cooperative management with the Wyoming Game and Fish Department, as well as private landowners, should be coordinated so that consistency is developed throughout the watershed for dealing with off-highway use violations.

Vegetation treatments designed to modify the age and structural composition of predominant shrub stands and stratify the seral stage mix within stands should be continued and/or initiated and implemented throughout the watershed. Although the inventory, classification, and categorization of shrubland habitat and impacts throughout the watershed should be continued and finalized as quickly as possible, treatments should continue in the interim in order to remove portions of decadent communities and manipulate the structure of others before they reach a stage of over-maturity which limits management options. Where treatments are utilized to improve the health and productivity of sagebrush and sagebrush/mountain shrub communities, they should attempt to promote juvenile, palatable shrub seedlings within the community in addition to increasing the herbaceous component. Where management units include decadent or dying (shrinking) aspen stands, treatments can incorporate design features to remove old, decadent, and diseased trees and material (via stand replacement), or at a minimum, remove understory vegetation and litter (with low-intensity, creeping flame fronts within stands) in order to promote suckering of new clones and turnover of the stand(s). Many juniper stands have reached stages of maturity and decadency, which preclude treatment by all but an undesirable, intense, stand-replacing crown fire or chemical treatment removing all existing vegetation. In these cases, management strategies could incorporate removal techniques such as limited mechanical treatment to create broken, open "islands" within the stand(s). Although mechanical treatments are in many cases prohibitively expensive, they may be the only remaining, viable treatment option for extensive old-aged stands that consist only of a juniper overstory with sparse, scattered understory vegetation. Removal of encroaching species (mostly juniper and some limited conifer encroachment within aspen stands) in manageable vegetation communities can be accomplished through the use of traditional, controlled-intensity prescribed burns removing vegetation in a mosaic pattern. Treatment methods and post-treatment management of burns designed to improve watershed health should (at least initially) maximize herbaceous vegetation and litter in order to provide healthy, productive forage and habitat for livestock and wildlife. Treatment and management objectives should strive to focus on and address changes and improvements to the predominant vegetative community rather than expected secondary effects (positive and negative) to narrowly-defined rangeland "users" (e.g., wildlife vs. livestock burns). Polarization from user groups and single resource advocates can be more effectively avoided if objectives specifically address rangeland vegetation health issues, rather than focus on what can be construed as single species or single use management. On a long-term basis, treatments and pre/post-treatment management should be designed to promote healthy, diverse, natural rangeland conditions rather than the creation of homogeneous monotype communities covering large tracts of land. Species, age, and structural diversity should be stressed in management plans rather than medium to long-term vegetation community “conversion” that continues current trends and conditions, albeit with different primary species.

Wild horse populations in the Adobe Town HMA should be reduced and maintained from current levels to AML of 600 to 800 horses. Bands of wild horses occupying rangelands outside the HMA should be removed or hazed into the HMA and combined into the AML population. Monitoring of impacts to the vegetation within the HMA should attempt to determine what effects wild horses have on their habitat when maintained at the desired population level and to what extent these effects are compatible with other multiple use activities occurring in the area. Develop additional water sources to reduce the dependence on existing water sources and the long duration to year-long use by wild horses around these sites to improve vegetative vigor, cover, and diversity.

Oil and gas extraction companies should be held to established reclamation standards on active and abandoned (dry hole) well pad sites in order to mitigate construction impacts to the disturbance site and to surrounding rangelands. Additionally, reclamation of former well-site access roads should be stringently inspected and enforced. Livestock management would be facilitated by properly constructing and promply repairing damage to fences and cattleguards caused by oil and gas activities. Construction and reclamation equipment should be thoroughly cleaned and inspected prior to movement between work sites to ensure that undesirable vegetation species are not carried and spread throughout the watershed.

STANDARD 4 - Wildlife/Threatened and Endangered Species/Fisheries Habitat Health, Weeds:

> *Rangelands are capable of sustaining viable populations and a diversity of native plant and animal species appropriate to the habitat. Habitats that support or could support threatened species, endangered species, species of special concern, or sensitive species will be maintained or enhanced.*

Wildlife/Threatened and Endangered Species

1) Characterization:

The plant communities/habitat types that occur within this watershed have been described under the Characterization section of Standard 2 (Wetland/Riparian Health) and Standard 3 (Upland Plant Health). These habitat types vary greatly in their ability to support wildlife, depending on species composition, age classes, single-species dominance, horizontal and vertical structure, type abundance, mosaic mix with other habitats, and proximity to features such as migration corridors and winter concentration areas. Over 374 species of wildlife, including birds, mammals, reptiles and amphibians, are known or are expected to occur within the Rawlins Field Office (RFO). While some wildlife species use several to many habitat types, other species are very specific in their habitat needs, and are known as obligate species. Graph #5 lists the number of wildlife vertebrate species by standard habitat type found within the Rawlins Field Office. In general, aquatic habitats support the greatest diversity of species (up to 165) and are the least common type of habitat (about 1% of landscape). Aspen woodlands are next in terms of supporting the greatest diversity of species, followed by big sagebrush, conifer, mountain shrub, and juniper woodland habitat types. The woodland plant communities are also uncommon in occurrence (about 4% of landscape), while big sagebrush and sagebrush/mixed grass are the most common plant communities in this watershed. Habitats with the lowest diversity of plants, cover, and structure, such as sand dunes, badlands, and rock outcrops, correspondingly support the lowest number of wildlife species.

Resource management plans have categorized these less common, high wildlife diversity habitats as higher priority for protection from impacts due to projects or other developments. This does not mean that more common habitats with lower wildlife diversity are any less important. The recent rise in the status of both the greater sage-grouse and mountain plover has also elevated the importance of managing the more abundant habitats of sagebrush, saltbush, and short grassland. Management of all habitats to be healthy in terms of diverse species, cover, age classes and structure, will ultimately provide the most optimum habitat for all wildlife, rather than trying to manage for each particular species or priority species, the status of which can change rapidly.

Species of Interest or Concern:

The mule deer herd designation in this watershed is the Baggs Herd Unit, which includes the area south of Interstate 80, north of the Colorado-Wyoming state line, west of the Continental Divide to Sage Creek and then north to Rawlins and east of the Bitter Creek Road (picture 67-1). Many of the low and mid-elevation areas are winter-yearlong habitat as long as water is available during dry periods. Crucial winter range is along the Colorado border from Savery to Powder Rim, up Muddy Creek in the bottoms and juniper woodlands, and in the Sand Hills area (see Map #7). The better summer habitat is in areas along streams, or where precipitation is 10 inches or higher that support greater production and diversity of forbs and shrubs. Recent studies have shown mule deer moving greater distances seasonally than previously suspected. Deer that spent their summer south of Rawlins on Atlantic Rim were found in the winter on Powder Rim west of Baggs. Mule deer prefer a mixed diet of forbs, grasses, and shrubs in the spring and summer, moving to mostly shrubs in the fall and winter months. Stands of bitterbrush, mountain mahogany, serviceberry, chokecherry, and snowberry are important shrub species to manage for deer. Utah juniper is also eaten, but is much more valuable as winter thermal and escape cover. Mule deer and antelope diets are very similar to that of domestic sheep and, therefore, they compete with these animals for forage where their use areas overlap. Since the herd management units for mule deer, antelope, and elk all border Colorado, there is extensive movement of animals back and forth between the states.

The antelope herd designations in this watershed are the Baggs and Bitter Creek Herd Units (picture 68-1). The Baggs Herd Unit is bounded by Interstate 80 to the north, the Colorado-Wyoming state line to the south, Highway 789 on the west, and Atlantic Rim and the Continental Divide to the east. Crucial winter range is located primarily along Muddy Creek between Dad and Baggs and on Red Rim along ridges that blow free from snow. The area along Muddy Creek overlaps with crucial winter range for mule deer. Antelope move farther west or south into Colorado during severe winters. During more mild winters, antelope make more extensive use of transition habitat adjacent to crucial winter range. While winter range is more limited, summer habitat for antelope extends across the entire herd unit except for the areas supporting forest woodland habitat. The Bitter Creek herd unit is bounded by Interstate 80 to the north, the Colorado state line to the south, by Highway 789 to the east, and Highway 430 to the west. Antelope are the principal big game species observed here, with mule deer and elk found in the Flat Tops and Powder Rim areas along the southern border. The wide open basins provide more season-long habitat, with antelope moving north to Patrick Draw or south to Colorado during more severe winters. Antelope rely heavily on Wyoming and mountain big sagebrush habitats in addition to other “open” communities like saltbush, greasewood, and short grasslands. During the winter, antelope diets may consist of up to 98% Wyoming big sagebrush. However, spring and summer diets include higher amounts of forbs, grasses, and other shrubs.

The elk herd designations in the watershed are the Sierra Madre and Petition Herd Units (picture 68-2). The Sierra Madre Herd Unit is bounded on the north by Interstate 80, Wyoming Highway 71, Sage Creek and the North Platte River, on the east by Wyoming Highways 130 and 230, on the south by the Colorado-Wyoming Stateline, and Wyoming Highway 789 on the west. This means that only about half of this management unit is contained within the upper Colorado River watershed. Elk will summer in the MBNF and surrounding foothills where there is aspen or other habitat to provide hiding cover. Elk move to lower elevations off the forest, with distances traveled often dictated by the availability of forage. Crucial winter ranges include the wind-blown rims south of Rawlins, stretching south along Atlantic Rim, the Sand Hills, and slopes bordering the Browns Hill plateau to the Little Snake River valley and Horse Mountain area. The Petition herd unit is bordered by Wyoming Highway 430 on the west, interstate 80 to the north, Wyoming highway 789 to the east, and the Colorado-Wyoming state line to the south. This is a relatively new herd management unit that was created in the 1990s after wintering elk began to stay year-round in this area. Because the elevation in this area is generally low, the elk do not generally move the distances as does the Sierra Madre herd. The principal elk cover in this area are juniper woodlands and patches of tall sagebrush and serviceberry. Elk primarily eat grasses, with a higher proportion of shrubs and aspen taken during the fall and winter. This predominately grass diet means that elk compete for forage with cattle and wild horses, rather than with antelope, mule deer, or domestic sheep.

Greater sage-grouse and Columbian sharp-tailed grouse both occur within this watershed (see Map #8 and pictures 68-3 thru 68-5). Greater sage-grouse populations have exhibited long-term declines throughout North America, 33% over the past 30 to 40 years (Braun 1998). No one causal factor has been solely identified for these declines. Wyoming supports the largest populations of greater sage-grouse, more than all other states combined. However, this population decline is also happening in Wyoming. Greater sage-grouse are a sagebrush obligate species. Throughout the life cycle of the species, sagebrush plays an important role; from breeding habitats of open areas surrounded by sagebrush to nesting sites under sagebrush to wintering habitat in sagebrush, each aspect of the life cycle requires slightly different elements within the sagebrush communities. It appears that during nesting, grass height and cover play an important role in the nesting success of greater sage-grouse. Early brood-rearing habitats may be relatively open stands of sagebrush with greater than 15% canopy cover of grasses and forbs. (Lyon 2000). Great plant species diversity with abundant forbs and insects characterize brood areas (Klott and Lindzey 1990). As summer progresses, grouse move to more mesic sites rich in forbs. Movements to winter range are slow and meandering and occur from late August to December (Connelly et al. 1988). During winter, greater sage-grouse feed almost exclusively on leaves of sagebrush (Patterson 1952,Wallestad et al. 1975). Currently, the Rawlins Field Office has contracted with industry for a consultant to complete a wintering sage grouse study within this watershed. The study is ongoing, and the purpose is to identify and describe greater sage-grouse severe winter relief habitat within two oil and gas environmental analysis areas. During the winter of 2000/2001, aerial surveys identified 25 separate areas being used by greater sage-grouse when snowfall restricted birds to small, exposed areas of sagebrush habitat.

Columbian sharp-tailed grouse occur only in this watershed within the RFO. Larger populations are found in northwest Colorado and two other separate populations are found in southern Idaho/Utah and British Columbia. Small, remnant populations exist in Washington and Montana. These birds occupy grasslands to open shrublands mixed with grasses with adequate cover (up to 40% shrubs) for nesting and brood-rearing habitat. Within the watershed, they occur in the foothills and forest edge from Savery and Battle Mountain north to Muddy Creek and Truckdriver's Creek. Young birds rely on insects and forbs before switching to berries in the summer and fall. Winter diets are primarily buds from taller berry-shrubs that stand above the snow, such as serviceberry and chokecherry. Taller roosting habitat is needed close to nesting and brood-rearing habitat and can include riparian habitat, aspen, and pockets of taller shrubs. The Colorado populations have not shown the declines of other states, but there is concern about the species' extensive use of private lands and artificial habitats (reclaimed minelands). In fact, 44% of active lek sites occur on these reclaimed mining areas and Conservation Reserve Program (CRP) lands (Hoffman, 2001).

Ferruginous hawks are common within the RFO and the upper Colorado River watershed (picture 69-1). Once proposed as a candidate for listing, it is currently on the Wyoming BLM sensitive species list. This hawk is maintaining stable populations in Wyoming, although it is still declining across its entire range. The local populations are primarily influenced by the abundance of prey, namely ground squirrels, which fluctuate with the trends in climate and vegetation. In the wide open rangelands that characterize much of the basins, lack of suitable nesting structures often leads to birds nesting on old structures, windmills, and oil and gas facilities. Use of artificial nesting structures has proven successful in alleviating these types of problems and actually improved fledgling rates.

Numerous other raptors live and nest in this watershed and include golden eagles; red-tailed hawks, Swainson's hawks, sharp-shinned hawks, and Cooper's hawks; northern harrier; American kestrels; prairie falcons; and burrowing owls, short-eared owls, long-eared owls, and great-horned owls (see Map #9). Other common species are jack and cottontail rabbits, coyote, red fox, skunk, badger, beaver, muskrat, ground squirrels, white-tailed prairie dogs, and a variety of songbirds and small mammals. Riparian habitat and wetlands support these species and numerous other migratory waterfowl and shorebirds, including the white-faced ibis and long-billed curlew.

T&E Species:

Threatened, endangered, proposed, and candidate species for listing that occur, or may occur, within this watershed include the black-footed ferret, Canada lynx, bald eagle, mountain plover, blowout penstemon, Ute ladies'-tresses, boreal toad, and yellow-billed cuckoo (picture 69-2). Also, since this watershed is a subset of the Colorado River System, any projects that lead to a water depletion in the system will affect the following fish species: bonytail chub, Colorado pikeminnow, humpback chub, and the razorback sucker

<u>Black-footed Ferret</u>

<u>Status</u>

The black-footed ferret is considered the rarest and most endangered mammal in North America and receives full protection under the Endangered Species Act of 1973 (P.L. 93-205).

<u>Habitat</u>

The close association of black-footed ferrets and prairie dogs is well-documented. The ferrets rely on prairie dogs for both food and shelter. The original range of the black-footed ferret corresponded closely with the prairie dog, extending over the Great Plains area from southern Canada to the west Texas plains and from east of the 100th Meridian to Utah and Arizona (USDI-BLM, 1984).

Watershed Occurrence
This watershed supports fairly large populations of white-tailed prairie dogs towns. Therefore, there is still the potential that the watershed may support black-footed ferrets. There are no known populations within the watershed. Black-footed ferrets have been reintroduced into the Craig BLM Field Office, which is just south of the watershed in Colorado.

Canada Lynx

Status

The current status of the Canada lynx is threatened.

Habitat

Lynx occur in the boreal, sub-boreal, and western montane forests of North America. Snowshoe hares are the primary prey of lynx, comprising 35-97% of their diet throughout the range. Other prey species include red squirrels, ground squirrels, mice, voles, porcupines, beaver, and ungulates as carrion or occasionally as prey. Lynx seem to prefer to move through continuous forest and particularly use ridges, saddles, and riparian areas. In studies in Montana and Wyoming, adult lynx made exploratory movements outside their home range, and lynx have been found to cross large rivers and lakes and have been documented in habitats such as shrub-steppe, juniper, and ponderosa pine (USDI-FWS, 1999a).

Watershed Occurrence

Although it is highly unlikely that lynx use the habitat types in which the watershed occurs, it is always possible that this animal may travel through the watershed, specifically using riparian habitats for cover.

Bald Eagle

Status

The current status of the bald eagle is threatened.

Habitat

Bald eagles are found in conifer, cottonwood-riparian, and river ecosystems and forage in adjacent upland rangelands.

Watershed Occurrence

Bald eagles live year-round in the Little Snake River drainage. They are most commonly observed on public lands during the winter and spring when they feed on big game carcasses along highways and on winter ranges.

Mountain Plover

Status

The U.S. Fish and Wildlife Service proposed listing the mountain plover as a threatened species in February 1999, without critical habitat, under authority of the Endangered Species Act of 1973.

Habitat

The mountain plover is a bird of short-grass prairie and shrub-steppe landscapes at both breeding and wintering locales. Breeding Bird Survey trends analyzed for the period 1966 though 1996 document a continuous decline of 2.7% annually for this species, the highest of all endemic grassland species. The plover is classified as common in Wyoming. Range management projects to improve forage conditions for domestic livestock, such as pitting, introduction of exotic grass species, watershed improvement projects, and fire suppression, enhance the development of taller vegetation and may eliminate suitable habitat for nesting plover (USDI-FWS, 1999b).

Watershed Occurrence

Within the watershed, mountain plovers appear to be fairly common during breeding and nesting, using short grassland, saltbush-steppe, and sagebrush-steppe habitats. Mountain plovers are rarely found near water and use both native rangelands and disturbed areas such as bedgrounds, reclaimed sites, and prairie dog towns. Currently the Rawlins Field Office, in cooperation with the oil and gas industry and the U.S. Fish and Wildlife Service (FWS) are surveying for mountain plover and their habitat n several EIS development areas in the watershed. There are also studies involving insect populations and plover diet selection to help further define habitats preferred by mountain plovers. Several mountain plover occupied habitat areas have been identified within the watershed, primarily in the more open habitat of the Barrel Springs drainage between Wamsutter and the Flat Tops. An occupied habitat area is defined as two or more observations within two miles of each other during one breeding season of any of the following: territorial adults, nests, adult distraction displays, or broods. Mountain plovers have a tendency to come back to the same areas each year to nest.

Blowout Penstemon

Status

The blowout penstemon is considered an endangered species and receives full protection under the Endangered Species Act of 1973.

Habitat

The blowout penstemon is located in areas of sparsely vegetated shifting sand dunes or wind carved depressions (blowouts). In Wyoming, so far, this species is found primarily on sandy aprons or the lower half of steep sandy slopes deposited at the base of granitic or sedimentary mountains or ridges.

Watershed Occurrence

No known population occurs in the watershed. There is potential habitat for the plant in the blowout areas of the Sand Hills between Cow Creek and Muddy Creek. Walt Fertig from WYNDD spent one day in this watershed looking for blowout penstemon in 2000. Survey results were negative.

Western Boreal Toad

Status

This species is a candidate species under the Endangered Species Act of 1973.

Habitat

The western boreal toad is found in riparian areas above 7,500 ft in elevation adjacent to and within the MBNF.

Watershed Occurrence

The southern Rocky Mountain population of the boreal toad has suffered drastic population reductions since the early 1980s thoughout the southern Rockies, and declines in the Sierra Madres have also been severe. Boreal toads may potentially be found at higher elevations within the watershed bordering MBNF lands.

<u>Ute's Lady's Tresses</u>

<u>Status</u>

The Ute's lady's tresses is considered a threatened species under the Endangered Species Act of 1973.

<u>Habitat</u>

The Ute's lady's tresses is a perennial, terrestrial orchid with stems 2 to 5 dm tall, narrow leaves, and flowers consisting of few to many small white or ivory flowers clustered into a spike arrangement at the top of the stem. It blooms from late July through August; however, depending on location and climatic conditions, orchids may bloom in early July or still be in flower as late as early October. This plant is endemic to moist soils in mesic or wet meadows near springs, lakes, seeps, and riparian areas within the 100-year flood plain of perennial streams ranging from 4,300-7,000 ft in elevation. It occurs generally in alluvial substrates along riparian edges, gravel bars, old oxbows. The orchid colonizes early successional riparian habitats such as point bars, sand bars, and low lying gravelly, sandy, or cobble edges, persisting in those areas where the hydrology provides continual dampness in the root zone through the growing season. The plant seems generally intolerant of shade and is found primarily in open grass and forb-dominated sites where vegetation is relatively open and not dense or overgrown.

<u>Watershed Occurrence</u>

The Ute's lady's tresses has not been found in this watershed. The plant occurs in all of the states that border Wyoming, so the FWS has concluded that the plant may occur about anywhere in the state that meets the habitat requirements.

<u>Yellow-billed Cuckoo</u>

<u>Status</u>

The yellow-billed cuckoo is a candidate species at this time.

<u>Habitat</u>

This species generally inhabits open woodlands and streamside habitat with willow, cottonwood, and alder groves; however, it has been observed in riparian areas west of the Continental Divide.

<u>Watershed Occurrence</u>

Within the watershed, the best habitat for yellow-billed cuckoos appears to be found on private lands. There may be a few relatively-small isolated parcels of habitat occurring on BLM lands.

Colorado River System Species

<u>Colorado Pikeminnow</u>

<u>Status</u>

The Colorado pikeminnow was listed as endangered in 1967.

<u>Habitat</u>

This fish evolved as the main predator in the Colorado River system. The Colorado pikeminnow is the largest cyprinid fish (minnow family) native to North America. The decline of the fish can be closely correlated with the construction of dams and reservoirs during the 1960s, the introduction of nonnative fishes, and the removal of water from the Colorado River system (USDI-FWS, 1992).

Potential Effects

Migration cues such as high spring flows, increasing river temperatures, and possible chemical inputs from flooded land are all factors that signal the onset of the reproductive cycle in Colorado pikeminnow. These factors, including high spring flows, are critical to maintain successful reproduction. In the summer, water flow requirements change, and a gradual decline of summer flows following spring scouring maintains the natural sediment transport equilibria, prevents siltation of spawning substrate, aids downstream drift of larvae, and creates productive nursery areas. High flows in late summer and fall reduce availability of nursery habitat for young Colorado pikeminnow. Stable flows in the winter reduce ice scouring of the shoreline habitats that are used by overwintering adults and young (Tyus, 1989).

Any water depletions that would occur as a result of a project may affect, and is likely to adversely affect, the range, distribution, and reproductive success of the Colorado pike minnow, which has the potential to decrease the likelihood of the species' survival and recovery.

Humpback Chub

Status

The humpback chub was listed as endangered in 1964.

Habitat

The humpback chub inhabits narrow, deep canyon areas and is relatively restricted in distribution. Although this fish has been regularly found dispersed in the Green and Yampa Rivers, the only major populations of humpback chub known to exist in the upper Colorado River basin are located in Black Rocks and Westwater Canyons of the Colorado River (USDI-FWS, 1992).

Potential Effects

Humpback chub spawning occurs shortly after highest spring discharge. There may be competition between this fish and channel catfish (Tyus, 1989). Water depletion that would occur as a result of projects may affect, and is likely to adversely affect, the range, distribution, and reproductive success of the humpback chub, which has the potential to decrease the likelihood of its survival and recovery.

Bonytail Chub

Status

The bonytail is listed as endangered. On January 22, 1988, a recovery plan for this species was established.

Habitat

Little is known about the biological requirements of the bonytail chub, as the species greatly declined in numbers in the upper basin shortly after 1960. Until recently, the FWS considered the species extirpated from the upper basin; however, a specimen which exhibited many bonytail characteristics was collected prior to 1992, possibly indicating that a small extant population exists. Large river reaches in the Colorado River are probably used by this species (USDI-FWS, 1992).

Potential Effects

This fish may exhibit the same water flow requirements as the Colorado pike minnow and the humpback chub; therefore, any water depletion that occurs as a result of a project may affect, and is likely to adversely affect, the likelihood of the reproductive success and survival of the bonytail.

Razorback Sucker

Status

The razorback sucker was listed as endangered in Colorado in 1979.

Habitat

The current distribution and abundance of the razorback sucker has been significantly reduced throughout the Colorado River system. The largest population of razorback suckers in the upper Colorado River basin is found in the upper Green River and lower Yampa River. Specific information on biological and physical habitat requirements of the razorback sucker is very limited, and habitat requirements for juvenile fish are also unknown (USDI-FWS, 1992).

Potential Effects

Spawning of the razorback sucker occurs with increasing flows associated with highest spring runoff. Curtailment of spring runoff in the mainstream Green River may be associated with loss of recruitment to the juvenile stage (Tyus, 1989). This fish may exhibit the same water flow requirements as these three fish listed above; therefore, any water depletions that occur as a result of projects may affect, and are likely to adversely affect, the likelihood of the reproductive success and survival of the razorback sucker.

BLM state sensitive species:

Many wildlife and plant species populations are declining, and though there may be many reasons for this, one of the causes of this decline is loss of suitable habitat from the landscape. The objective of the sensitive species designation is to ensure that BLM consider the overall welfare of these species when undertaking actions on public lands and that these actions do not contribute to the need to list the species under the provisions of the Endangered Species Act. The lack of demographic, distribution, and habitat requirement information compounds the difficulty of taking management actions for many species.

It is the intent of the BLM state sensitive species policy to emphasize the inventory, planning consideration, management implementation, monitoring, and information exchange for the sensitive species on the list in light of the statutory and administrative priorities.

BLM state sensitive species occurring in the watershed include: greater sage-grouse, Columbian sharp-tailed grouse, ferruginous hawk, white-faced ibis, long-billed curlew, burrowing owl, sage thrasher, loggerhead shrike, sage sparrow, Brewer's sparrow, white-tailed prairie dog, swift fox, Colorado River cutthroat trout, roundtail chub, bluehead sucker, flannelmouth sucker, and Gibbens beardtongue. Species thought to occur within the watershed are: Baird's sparrow, boreal toad, great basin spadefoot, northern leopard frog, Nelson's milkvetch, pale blue-eyed grass, dwarf shew, Wyoming pocket gopher, long-eared myotis, and Townsend's big-eared bat.

Species Common Names	Scientific Name	Habitat
Greater Sage-Grouse	*Cenrocercus urophasianus*	Basin-prairie shrub, mountain-foothill shrub
Columbian Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*	Grasslands
Ferruginous Hawk	*Buteo regalis*	Basin-prairie shrub, grassland, rock outcrops
White-Faced Ibis	*Plegadis chihi*	Marshes, wet meadows
Long-Billed Curlew	*Numenius americanus*	Grasslands, plains, foothills, wet meadows
Burrowing Owl	*Athene cunicularia*	Grasslands, basin-prairie shrub
Sage Thrasher	*Oreoscoptes montanus*	Basin-prairie shrub, mountain-foothill shrub
Loggerhead Shike	*Lanius ludovicianus*	Basin-prairie shrub, mountain-foothill shrub
Sage Sparrow	*Amphispiza billineata*	Basin-prairie shrub, mountain-foothill shrub
Brewer's Sparrow	*Spizella breweri*	Basin-prairie shrub
White-tailed Prairie Dog	*Cynomys leucurus*	Basin-prairie shrub, grasslands
Swift Fox	*Vulpes velox*	Grasslands
Colorado River Cutthroat Trout	*Oncorhynchus clarkipleuriticus*	CO River drainage, clear mountain streams
Roundtailed Chub	*Gila robusta*	CO River drainage, mostly large rivers, also streams and lakes
Bluehead Sucker	*Catostomus discobolus*	Bear, Snake and Green drainages, all waters
Flannelmouth Sucker	*Catostomus latipinnis*	CO River drainage, large rivers, streams and lakes
Gibbens Beardtongue	*Penstemon gibbensii*	Sparsely vegetated shale or sandy – clay slopes 5,500-7,700'
Baird's Sparrow	*Ammodramus bairdii*	Grasslands, weedy fields
Great Basin Spadefoot	*Spea intermontana*	Spring seeps, permanent and temporary waters
Northern Leopard Frog	*Rana pipiens*	Beaver ponds permanent and temporary waters
Nelson's Milkvetch	*Astragalus nelsonianus* –or- *Astragalus pectinatus var. platyphyllus*	Alkaline clay flats, shale bluffs and gullies, pebbly slopes, and volcanic cinders in sparsely vegetated sagebrush, juniper, & cushion plant communities at 5200-7600'
Pale Blue-Eyed Grass	*Sisyrinchium pallidum*	Wet meadows stream banks, roadside ditches, & irrigated meadows 7,000-7,900'
Dwarf Shew	*Sorex nanus*	Mountain-foothill shrub, grasslands
Wyoming Pocket Gopher	*Thomomys clusius*	Meadows with loose soil
Long-Eared Myotis	*Myotis evotis*	Conifer and deciduous forests, caves, and mines
Townsend's Big-Eared Bat	*Corynorhinus townsendii*	Forests, basin-prairie shrub, caves, and mines

2) Issues and Key Questions:

The critical objective with regards to wildlife is maintaining or improving the quality of habitat while still providing for human uses. This watershed area includes a number of priority habitats. These habitats contain important plant communities or terrestrial features that are important to wildlife. Priority wildlife habitats include streamside riparian areas, seeps, meadows, wetlands, sagebrush-grass communities, quaking aspen groves, saline influenced communities, such as saltbush steppe or greasewood lowlands and playas, juniper woodlands and mountain-foothills shrublands. Some of the terrestrial features may include cliffs, badlands, and caves/mines.

The issue that most directly impacts wildlife and their habitat is livestock grazing (picture 76-1). Livestock compete with wildlife for forage, water, and space. Livestock management can affect species composition, vegetative health and production, and vertical and horizontal structure of habitats that wildlife depend upon. Tools used in livestock management, such as water developments, fencing, and treatments, may have positive and negative impacts depending on the species of wildlife, habitat requirements, and the cumulative impacts. The most visible issue with livestock grazing is cattle impacts on riparian habitat. How can cattle grazing be managed to maintain healthy vegetation in riparian areas, seeps, springs, meadows and wetlands? These areas support the greatest diversity of wildlife species and occur on only about one percent of the landscape; therefore, they must be managed for all beneficial uses. Another important issue is fencing, both existing and proposed projects. This includes the location, design, and cumulative impacts that fences can have on big game movements, migration corridors, and within crucial winter ranges. New fences are constructed to BLM standards, which were designed to minimize impacts to wildlife. However, older fences are not constructed to these standards, and can cause impediments to wildlife (i.e. sheep type designs). How can older style fences be converted in a timely manner to “wildlife friendly” standards, and how can cumulative impacts from fences on big game and other wildlife be adequately assessed? Another livestock related issue is water development projects in wildlife crucial winter ranges. How can livestock distribution problems be resolved without promoting year-round wildlife use and ensuring adequate forage is available for wildlife?

Second to livestock in directly competing with wildlife are wild horses, which occur in the western third of the evaluation area. While they don’t tend to congregate around water sources as much as cattle, wild horses compete with wildlife on a year-round basis for water, forage, and space. During times of drought, which is the current situation, there are less resources and increased competition. To compound this, current wild horse populations are 2 ½ times the estimated desired population. Within the wild horse herd management area, current wild horse use is equal to livestock potential use (preference). However, due to nonuse by permittees because of wild horse numbers and drought, livestock use in 2001 was only 33% of the use by wild horses. What impacts are occurring to wildlife and their habitat as a result of too many wild horses? What steps or political processes must occur in order to keep wild horse populations at responsible levels?

Healthy populations of wildlife require healthy habitat. What constitutes healthy habitat? The best one-word answer is diversity. Diversity of plant species within communities and diverse amounts of plant cover and age structure. Many plants, and plant communities, require some sort of disturbance, such as disease, fire, or climate change to provide the mechanism to start afresh. Aspen and chokecherry are two species which require fire to stimulate regeneration and reduce competition from other species. The lack of fire or other forms of disturbance has resulted in many shrub and tree populations with too many old plants and not enough young ones. Wildlife which like older, denser plant communities are currently thriving, but the ones that like younger, more open habitats with early successional species are not doing as well. How many young plants or communities should we have and what is the right mix of young, middle-aged and old plants or communities to support diverse and healthy populations of wildlife? What are the best tools, such as fire, chemicals, or mechanical methods, to achieve this mixture?

An issue that is expanding at a rapid rate is mineral/oil and gas development, both in the scope of area in which impacts occur and the scale, particularly with in-field drilling (picture 76-2). Wildlife concerns involve fragmentation of habitat, which breaks undisturbed vegetation into smaller and smaller units. This is usually caused by roads, pipelines, utility corridors, and other facilities constructed in or across previously undisturbed habitat. Road development also results in increased human presence or activity, either by industry or public recreation. Wildlife may be negatively impacted by these activities due to increased stress, movement and energy loss at critical seasons, and total loss of habitat through avoidance of these areas. With some species like greater sage-grouse, noise from industrial developments may also be an impact deserving greater recognition. How can mineral development proceed without creating impacts to wildlife and their habitat? Should additional measures be implemented to reduce impacts from mineral development and associated recreational use, such as seasonal road closures in crucial winter ranges? Can resources be developed in such a way as to minimize fragmentation of habitat?

In addition to increasing vehicular access by the public through road development, there is also an expanding off-highway vehicular impact from people driving their pickups, motorcycles, and three/four-wheelers anywhere they can. Whether for hunting, joy-riding, or collecting antlers, these activities can cause the same types of impacts to wildlife as described above: stress, energy loss with movement, and loss of habitat through avoidance of activity areas. Laws and enforcement can not work everywhere at all times. How can members of the general public be educated or informed to make better decisions about where and when they use their off-highway vehicles?

Wildlife also compete with other wildlife for forage, water, and space. This competition has often been studied between species of big game, particularly between elk and mule deer, since one seems to be up when the other is down. Although there is a moderate overlap in winter diets, primarily shrubs, there is little else to quantify and substantiate the competition between them. In many cases, the data supports habitat health and trend as the principal factor in determining whether one species does better than another. In 1994, the WGFD published the Baggs Mule Deer Crucial Winter Range Analysis. It documented a 74% winter diet overlap between mule deer and antelope in this area. Despite this fact and the concern over the health and trend of mountain shrub communities within mule deer crucial winter range, antelope herd objectives were raised in the late 1990s. There is currently a heightened concern over the national trend in greater sage-grouse numbers, with habitat the principal factor in question. Deer and antelope doe/fawn ratios are down from historic figures, so herds don’t grow as fast or bounce back after winter die-offs. The banning of poisons and reducing hunting pressures over the last 20 to 30 years has led to increased predator populations. With this will come shifts in predator/prey balances and relationships. Do the current wildlife herd objectives have the habitat to support them? Should we concentrate more on spring through fall ranges and the health of the animals going into the winter, rather than on the condition of the winter range itself? Are trends in wildlife populations relating to changes in inter-species competition and not just changes in habitat, climate, or impacts from human uses?

3) Current Conditions:

Refer to Current Conditions for Standards #2 and #3 for habitat descriptions.

4) Reference Conditions:

The following are excerpts from “The Wyoming Landscape, 1805–1878,” regarding the Little Snake River valley. The earliest Euro-American to visit and document his observations was F. A. Wislizenus, a St. Louis physician, who passed through the area in August of 1839. As his party approached Savery Creek from the Baggs area, buffalo were observed singly and in small herds. E. Willard Smith accompanied the fur trading party of Vasquez and Sublette into the area in the fall and winter of 1839-40. His party killed some buffalo and grizzly bears in mid-October of 1839 near the confluence of Muddy Creek and the Little Snake River. In early February of 1840, they returned to this same area and killed more buffalo.

In 1844 John C. Fremont, an army topographer, was also a visitor to this area. They killed three antelope west of Baggs. They then turned more northward across the hills “where every hollow had a spring of running water, with good grass.” They shortly began seeing buffalo. On “St. Vrain’s fork” (Savery Creek) they killed some bighorn sheep and buffalo. The creek was only wooded with willow thickets. There were aspen groves on the hills above. A band of elk was chased from one of these groves. Antelope were running over the hills and herds of buffalo could be seen on the opposite river plains. They also shot some deer. “The country here appeared more variously stocked with game than any part of the Rocky Mountains we had visited; and its abundance is owing to the excellent pasturage, and its dangerous character as a war ground.”

In 1850, Howard Stansbury, another army topographer who was part of a group surveying the route for the Overland Trail, wrote the following while crossing the Barrel Springs Draw portion of the Muddy Creek watershed. Tuesday, September 17: “Several buffalo were seen today, and one antelope killed.” Wednesday, September 18: “A few buffalo bulls were quietly grazing upon the plain, and now and then a small herd of antelope, bounding away over the hills, gave life and spirit to the picture. An occasional drain was crossed, which gave indications of having contained water quite recently; but all of these were now dry. As long as the water lasted, the whole plain must have been covered with buffaloe and antelope, as the profusion of sign abundantly proved; but as this indispensable article was absorbed by the sandy soil, they seemed, from the direction of their trails, to have struck a course for the Vermillion. Many large bear-tracks were also seen, making in the same direction.”

W. A. Richards was with the party that surveyed the southern border of Wyoming in 1873. At their camp just east of Sheep Mountain, “Lon and Texas caught a fine string of trout and Pat killed a goose.” The next day “Max went out in the morning on Sheep Mt. just west of here and killed a mountain sheep and an antelope. Lon went out in p.m. after supper and killed a sheep and a black-tailed buck….Boys caught lots of trout.” The next day Campbell killed two antelope. The following day “I killed a young buck on the steep side of the Mt.” On August 7, Lon “killed a black tailed buck. Have high living nowadays and no work (weather bad for observations). Deer, antelope, sheep, geese, trout and grouse” are here.

Livestock first came to the area in 1871 when Noah Reader settled near the mouth of Savery Creek with a few head of cattle (Barnhart 1969). Later, in early 1873, George Baggs brought around 2,000 head of cattle to the Little Snake River Valley (Burroughs 1962). Cattle were the principal type of livestock until severe winters in 1886-87 and 1889-90 left some livestock owners bankrupt and opened the door for sheepmen to enter the picture. In the early 1900s, problems between cattle and sheep operators led to an agreement, where cattle would be grazed south of the Colorado-Wyoming state line and sheep to the north. Sheep numbers peaked in Carbon County between 1910-1920 at over ½ million sheep. Grazing on unclaimed public lands (what became BLM-managed lands in 1946) was widespread and uncontrolled until 1934. At this time the Taylor Grazing Act was enacted, which created grazing allotments and allocated grazing privileges. Giving ranchers their own area to graze and care for helped begin the process of improving resource conditions, which also meant improving habitat conditions for wildlife. As sheep numbers have dropped over time and allotments converted from sheep to cattle grazing, management concerns have become more focused on riparian habitat, which is usually more prone to impacts from cattle use.

5) Synthesis and Interpretation:

From the accounts above, the detectable changes are the disappearance of buffalo, grizzly bears, and bighorn sheep from this area. Livestock impacts, although still present, have been reduced, and range conditions on uplands and riparian habitat are improving in most areas. Antelope, elk, and mule deer are generally thriving, and Wyoming has the largest population of greater sage-grouse in the country. The principal reason for this is the slower settlement and development in Wyoming, compared to other states, which has slowed the rate of habitat loss and fragmentation. Our native plant species are all still present and weeds, though an issue, have not taken over large areas of the range. However, there is still progress to be made. Improvement in resource conditions following changes in livestock management can take many years to reach desired conditions. Lack of fire has created mature to decadent shrub and woodland communities with lower vigor and poor age-class and species composition. Wild horse population levels are currently above objective in a long-term drought with potentially large impacts on wildlife habitat. Impacts from oil and gas development, off-highway vehicles, and loss or modification of habitats near towns and outlying homes continue to increase.

The current status of big game herd levels and population objectives are: Antelope numbers within the Bitter Creek herd unit are currently between 12,000-14,000. In 1994 , the population objective was changed from 11,000 to 25,000. Antelope numbers within the Baggs herd unit are currently 7,000-7,500.

This population objective was also raised, from 7,100 to 9,000 animals. Prior to raising these objectives, antelope populations had tended to be at or above objective levels in most years. Habitat for antelope is in good condition for the Bitter Creek herd (picture 79-1). Whether the current herd objective is supportable is not yet known. Principal concerns are with the Baggs herd in terms of the 74% diet overlap with mule deer in this area and the high concentration of animals in the Muddy Creek crucial winter range during severe winters caused by Highway 789. Current trends in this sagebrush community are stable. However, as populations are raised toward the higher population objective, and if more severe winter weather returns to this portion of Wyoming, the trend in these communities will have to be closely watched. Perhaps compounding this issue is the potential coalbed methane field development in antelope transition range and adjacent to crucial winter range. This transition range is important in receiving more use by antelope in milder winters and reducing the browsing pressure on the crucial winter range (pictures 79-2, 79-3). If disturbances in this transition range lead to less antelope use here and more use of the crucial winter range, it will likely lead to downward trends in the Wyoming big sagebrush communities in crucial winter range.

Elk numbers within the Sierra Madre herd unit are currently around 6,300. This is about 2,100 above the population objective of 4,200 animals, and this herd has been above objective for 5+ years. The Petition elk herd unit has a population objective of 300 animals and is close to that number. This herd has been slowly building up to objective and can vary a lot due to migration to and from other herd units. Habitat for elk is abundant, generally healthy, and capable of supporting the existing herd objectives and potentially higher numbers. Elk from the Sierra Madre herd are pushing winter habitat boundaries farther to the north and west due to improved forage condition and prescribed burning (picture 79-4).

Mule deer numbers within the Baggs herd unit are near or at objective with an estimate of around 17,800 mule deer. They have been at this objective for 5+ years, but were previously as high as 27,000 in 1987, prior to a winter die-off in February 1993. Of the three commonly found big game species in this watershed, their habitat, and particularly crucial winter range, is of the highest concern. The first sidebar to addressing this concern is that some areas within the crucial winter range are more heavily impacted than others. The most concentrated mule deer use occurs from Horse Mountain down to Poison Basin and north along Muddy Creek, at lower elevations (79-5, 79-6). Adjacent to this area and to the north and west are areas in better condition that are used in mild winters but act more as transition habitat in severe winters (picture 79-7). The second factor is that a much higher percentage of mule deer crucial winter range is on private lands than compared to antelope and elk crucial winter range. Therefore, federal land managers should be aware of and take into account (when possible) actions occurring on lands adjacent to public lands and realize that actions taken on public lands will only affect perhaps 20% of the most heavily utilized areas within the crucial winter range.

Observed habitat concerns in the mule deer crucial winter range include single species dominance by Utah juniper and big sagebrush species, mature-to-decadent age class structure of all shrub communities, poor vigor and heavy-to-severe utilization of desired shrub species, dense stands of shrubs that inhibit use and movement, and low composition of forbs on deer ranges used first in the spring (picture 79-8). The Baggs Crucial Mule Deer Winter Range Analysis (WGFD, 1994) states the following about the need for vegetative treatments under Management Recommendations: "Fire suppression in some areas of the crucial winter range has had a negative impact on browse condition. Areas that were historically a mosaic of varying age classes of important browse species are now primarily older stands with considerable dead or decadent shrubs. Sage-grass communities, especially in Area IV(Flattops, Powder Rim), are now dominated by climax stands of big sagebrush with very little diversity in age and species composition." Other concerns are wildfire potential in the Sand Hills and above Dixon and Savery that could burn large blocks of crucial winter range; impediments to deer movement such as fences in poor locations or not constructed to BLM standards or sheep-style fences that are no longer needed and restrict movement, and seasonal disruptions to deer on crucial winter range from the activities of commercial users and recreationists on improved and unimproved roads and cross-country (pictures 79-9, 79-10). There is also potential to improve lower-value mule deer habitat such as the alkali sagebrush habitat in the transition range northeast of Baggs.

Habitat for grouse, both greater sage-grouse and Columbian sharp-tailed grouse, could be improved (picture 79-11). The recommendations in recent publications about greater sage-grouse nesting and early brood-rearing habitat features, which was developed in Idaho and then modified based on research conducted in Wyoming, can be used for assessments and to justify treatments (picture 80-1). In a study completed within this watershed, sharp-tailed habitat typically contained 28% shrub cover, while greater sage-grouse habitat consisted of areas with total shrub cover averaging 30% (Klott, 1987). In many cases, existing grouse habitat contains too much big sagebrush, lack of species diversity and forb abundance, and not enough herbaceous residual cover for high nesting success. Although Wyoming does have healthy grouse populations, there are still many opportunities in which habitat conditions can be improved for grouse and all wildlife which utilize these plant communities.

6) Recommendations:

Habitat needed to support healthy wildlife populations and listed or proposed threatened and endangered species is generally in acceptable condition. This does not mean that there aren't problems or concerns about wildlife habitat. The discussion under Standard #2 – Wetland/Riparian Health and Standard #3 – Upland Plant Health outlines the current conditions and recommendations for improving management of these resources. In many cases we may be meeting a standard but have a ways to go in order to meet our "desired or future" condition. On the other hand, our composition of native species is good, with just spot problems at this time with weeds. Due to the existing good condition of native vegetation and its ability to support the diverse wildlife populations we currently have, it is determined that the majority of Upper Colorado River watershed is meeting Standard #4 with respect to wildlife. The principal area deemed not to be meeting Standard #4 for wildlife habitat is the mule deer crucial winter range located between Horse Mountain and Poison Basin and north from Baggs along Muddy Creek through the Wild Horse and Dad juniper woodlands. This area encompasses about 40,000 acres of public land. The following recommendations address action to help meet future desired resource conditions. Livestock grazing is not a principle factor in the non-attainment of this standard.

Implement recommendations described for Standards #2 and #3. Improving the health of riparian/wetland and upland plant communities will help meet the needs of all wildlife, which use this watershed.

Modify existing sheep-type fences and older cattle-type fences to meet BLM standards. When possible, relocate fences to reduce impacts to wildlife movements. Encourage livestock permittees to leave gates open when not needed and/or through as much of the fall through spring seasons to help wildlife move between seasonal ranges.

Implement treatments in and adjacent to crucial winter ranges to improve the diversity of cover, species, age-class, vertical structure, and mosaic mix of plant communities. This may require experimentation on small scale projects, such as juniper woodland and alkali sagebrush, to determine which type(s) of treatments are most effective in meeting resource objectives. In fire-sensitive communities, create fire control zones of sparser vegetation between blocks of denser vegetation to reduce the likelihood of large wildfire impacts.

Management plans should consider other grazers, such as wildlife and wild horses, in making recommendations and to properly assess impacts. Water developments should benefit as many species as possible. This includes running projects in the summer even after livestock have left. In winter ranges, projects should be controllable, or small (ephemeral) in nature, to not encourage year-round wildlife use. Monitoring information, particularly trend data for big game crucial winter range, should be shared with the WGFD for use in evaluating and changing herd objective levels.

Management efforts should also emphasize maintaining or improving the health of vegetative communities on spring/summer/fall ranges. Big game, as well as other wildlife, will be in better condition going onto winter ranges in the fall if spring and summer ranges are in optimum condition. Utilize habitat recommendations for greater sage-grouse and Columbian sharp-tailed grouse in both assessing and planning habitat treatments.

Reduce and maintain wild horse populations within established herd population levels. Monitor to evaluate the impacts on vegetative communities and wildlife habitat and whether these levels represent a proper long-term population of wild horses.

Evaluate the need and institute measures where necessary to reduce disturbance to big game species on crucial winter ranges, particularly mule deer. This could involve seasonal closures of roads, seasonal closures of habitat for antler collecting, general off-highway vehicle use, transportation planning for oil and gas development, and other activities.

Fisheries: Aquatic Populations and Viability

1) Characterization:

The native fishes inhabiting the waters of the Muddy Creek and Little Snake River watersheds of south-central Wyoming include members of the families Salmonidae (trout and salmon), Catostomidae (suckers), and Cyprinidae (minnows). These fishes are the Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker (*Catostomus discobolus*), mountain sucker (*Catostomus platyrhynchus*), roundtail chub (*Gila robusta*), and speckled dace (*Rhinichthys osculus*) (Baxter and Stone 1995, Wheeler 1997, Oberholtzer 1987). Several of these species have experienced population declines throughout their native range in the Colorado River basin and are currently listed on the BLM Wyoming Sensitive Species List (picture 81-1).

Salmonid Fishes

Colorado River Cutthroat Trout

The Colorado River cutthroat trout (CRCT) historically occupied habitats within the Colorado River basin in Wyoming, Colorado, Utah, Arizona, and New Mexico. This range likely included portions of large rivers such as the Green, Yampa, White, Colorado, and San Juan rivers as well as small headwater streams. The historical distribution of this subspecies was disjunct. It has been suggested that CRCT were absent from the lower reaches of many large rivers because of summer thermal barriers (Behnke and Zarn 1976). These thermal barriers may have become acceptable habitat in winter, which allowed for the movement of fishes among populations and the maintenance of disjunct populations. Most remaining populations of CRCT are fluvial (utilize tributaries for spawning) or resident and generally occupy a home range of less than 1,000 linear meters of stream (Young 1995).

The habitat requirements of CRCT are thought to be typical of other cutthroat subspecies, requiring cold, clear, well-oxygenated water. CRCT spawn in substrate predominantly composed of gravel (Young 1995). Bozek and Rahel (1991a) found summer fry densities to be related to sites with water velocities slower than 6 cm/s and water deeper than 3 cm, many of which were sheltered from higher water velocities by woody debris, boulders, and rootwads. Adult CRCT favor pool habitat, though the importance of individual pool types is not clear (Herger 1993, Young 1995).

CRCT evolved in the absence of other trout species. This evolutionary path has left this subspecies, like other inland forms of the species, vulnerable to hybridization with rainbow trout and to displacement by brook trout and brown trout (Behnke 1992). Land use practices that may affect populations of CRCT including overgrazing (Binns 1977), willow spraying (Little Snake River Working Group 1994), removal of beaver, heavy metal pollution (Oberholtzer 1987, Jespersen 1981, Quinlan 1980), and water depletion and diversion (Jespersen 1981).

The CRCT is currently designated as a special status species by the states of Colorado, Utah, and Wyoming as well as regions 2 and 4 of the USFS and the BLM in Colorado, Utah, and Wyoming. In April 2001, representatives of these agencies finalized the *Conservation agreement and strategy for Colorado River* *cutthroat trout (Oncorhynchus clarki pleuriticus) in the States of Colorado, Utah, and Wyoming* in order to ensure the long-term prosperity of CRCT throughout their historic range (CRCT Task Force 2001). The goals and objectives of this conservation agreement and strategy currently guide management of CRCT in the states of Colorado, Utah, and Wyoming.

Catostomid and Cyprinid Fishes

Some of the least studied fishes in the Colorado River Basin are members of the families Catostomidae (suckers) and Cyprinidae (minnows). Most people do not recognize the native fish fauna of this region as an indication of ecosystem function or sustainability. For this reason, these fishes have received little attention. The common names given many of these native fishes can be confusing as well. The term "minnow" is generally a reference to a little fish, while the term "sucker" is often used to describe a bottom-feeding scavenger. In reality, the Cyprinidae family (minnows) includes species that can grow rather large, such as the roundtail chub, which can easily reach lengths of 13 inches in the Muddy Creek watershed. Most members of the Catostomidae family (suckers) eat a combination of algae and aquatic invertebrates similar to other stream fishes (Rinne and Minckley 1991).

Flannelmouth Sucker

The flannelmouth sucker is native to the Colorado River drainage basin, where it is known to occupy both mainstem and tributary streams. It resides in pools, deep runs, and riffles. Similar to the behavior of other members of this genus, it ascends streams in the spring to spawn. This species is a benthic omnivore, consuming algae, detritus, plant debris, and aquatic invertebrates. Little is known of the habitat requirements of the flannelmouth sucker. Wyoming BLM, as well as the Wyoming Game and Fish Department, have designated the flannelmouth sucker as a sensitive species.

Bluehead Sucker

Bluehead suckers are known to occur within the Colorado River basin, as well as in portions of the Bonneville Basin and Snake River drainages (Lee et al. 1980). Migratory spawning behavior has been documented in the spring within Kanab Creek, Arizona, and tributaries of the Snake River in Wyoming (Maddux and Kepner 1988, Baxter and Stone 1995). Bluehead suckers are often associated with large, cool (20° C) streams with rocky substrates (Utah DNR 2002). This fish is a facultative herbivore, consuming algae, detritus, plant debris, and occasionally aquatic invertebrates (Utah DNR 2002). Algae are scraped from rocks by utilizing rigid cartilaginous biting edges of the jaws. Wyoming BLM, as well as the Wyoming Game and Fish Department, have designated the bluehead sucker as a sensitive species.

Mountain Sucker

The mountain sucker is a widely-distributed species occurring in the Columbia, Fraser, Saskatchewan, Missouri, and Green River drainages. It can be found in large rivers, small creeks, and montane lakes. Spawning takes place in the late spring to early summer. Mountain suckers feed primarily on algae. Like the bluehead sucker, algae are scraped from rocks by utilizing rigid cartilaginous biting edges of the jaws. The mountain sucker is categorized as a sensitive species by the Wyoming Game and Fish Department.

Roundtail Chub

The roundtail chub occurs in the Colorado River basin in both mainstem and tributary streams. Information pertaining to the seasonal movements of roundtail chub is scarce. Roundtail chub are carnivorous, opportunistic feeders, consuming a combination of insects, fish, snails, crustaceans, algae, and occasionally lizards (Osmundson 1999, Brouder 2000). Roundtail chubs occupy pool and riffle habitats that they use for cover and feeding. They do not tend to utilize shallow water habitats and areas lacking cover. Habitat requirements for all age classes of roundtail chub include a variety of substrate types from silt to sand and gravel to rocks, and turbid water rather than clear (Sigler and Sigler 1996, Brouder et al. 2000). Wyoming BLM, as well as the Wyoming Game and Fish Department, have designated the roundtail chub as a sensitive species.

Speckled Dace

The speckled dace is native to drainage basins west of the Continental Divide and ranges north into Canada. It can inhabit both streams and lakes. These fish are omnivorous feeders, consuming a combination of vegetable matter, insects, snails, and plankton (Baxter and Stone 1995). This species has a remarkable capability to survive periods of drought in pools of the deepest and most permanent parts of a channel, even though the water in these habitats becomes heated and deoxygenated. It can then re-colonize former habitats a few hours or days upon the return of streamflow (Rinne and Minckley 1991).

<u>Introduced Fishes</u>

Fish species introduced to the Muddy Creek and Little Snake River watersheds include the creek chub (*Semotilus atromaculatus*), white sucker (*Catostomus commersoni*), Iowa darter (*Etheostoma exile*), sand shiner (*Notropis stramineus*), fathead minnow (*Pimephales promelas*), brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), and brown trout (*Salmo trutta*) (Baxter and Stone 1995, Wheeler 1997, Oberholtzer 1987). Additional information regarding the life history and ecology of these species can be found in Baxter and Stone (1995).

2) Issues and Key Questions:

<u>Salmonid Fishes</u>

In 2001, the BLM signed the *Conservation agreement and strategy for Colorado River cutthroat trout (Oncorhynchus clarki pleuriticus) in the States of Colorado, Utah, and Wyoming* in order to coordinate conservation actions among agencies and states and remove or reduce threats to the long-term persistence of CRCT range-wide. One goal in this plan is the creation of two self-sustaining metapopulations, each consisting of five separate, viable but interconnected subpopulations, in each Geographic Management Unit (GMU). One of these GMUs is located within the boundaries of the Rawlins Field Office – the Little Snake River GMU. A conservation plan specific to this GMU was signed in 1994 to guide specific conservation actions (Little Snake River Working Group 1994). This plan established the upper Muddy Creek watershed as a reintroduction site for one of the metapopulations. Goal 2 of this plan is to "Restore continuous habitat previously occupied by Colorado River cutthroat trout and other endemic species (i.e., mottled sculpin, flannelmouth sucker, and roundtail chub) in sufficient quantities to assure stable populations of these endemic species within the Little Snake River drainage. This habitat must provide unobstructed routes to areas critical for fulfilling life history requirements of the species of concern." In order to accomplish this goal it is necessary to restore habitat conditions and, in preparation for reintroduction, remove non-native fishes that have potential to hybridize with and compete with CRCT.

Specific management actions completed or initiated to restore continuous habitats for CRCT include the implementation of livestock management practices such as rotational grazing systems, the removal of barriers to fish movements, the enhancement of spawning habitats, and the stabilization of areas of stream channel degradation (picture 83-1). One focus of habitat restoration efforts has been the reestablishment of "Proper Functioning Condition" (PFC) to streams of the upper Muddy Creek watershed. Tremendous progress has been made toward reaching this goal (pictures 83-2, 83-3). However, the PFC method was designed to address stream stability, not fish habitat. For this reason, streams classified as functioning properly may not provide all of the habitat components necessary to support CRCT. For example, the PFC assessment method does not address water temperature, but maximum water temperature has been shown to limit trout populations. Desired future condition beyond PFC, and associated shading cover for streams, especially mature shrubs, will take up to 10-20 years to accomplish. For CRCT to thrive in the upper Muddy Creek watershed, or elsewhere, it will likely be necessary to manage these streams in favor of late-successional stream habitat, rather than stopping management when stream stability has been achieved. Two components of late-successional stream habitats that could improve the success of CRCT reintroduction are the amount of coarse woody debris (willows) for cover and shading and the amount of gravel substrates available for spawning. It is currently not possible to assess the success of previous habitat restoration activities for CRCT in the upper Muddy Creek watershed, though the survival of fish reintroduced to Littlefield Creek through their first winter in 2002 was encouraging. The true test of the habitat's suitability will be if CRCT are able to complete their life cycle within the upper Muddy Creek watershed.

In addition to physical habitat restoration, actions have been completed or initiated to remove competing introduced species from areas identified for CRCT reintroduction. It must also be recognized that recreational fishing opportunities will be temporarily impacted while the removal of introduced fishes is completed. Those waters would then be restocked with native CRCT, thus replacing one fishing opportunity with another. Opportunities to enhance beaver habitats in Littlefield Creek while stabilizing areas of vertical instability have been pursued. The use of beaver as a tool to manage both stream stability and fish habitat has been very successful. Beaver ponds in Littlefield Creek have the potential to produce fish of a larger than average size, creating a unique angling opportunity. Additionally, removing competing species and reestablishing a trout fishery in upper Muddy Creek for CRCT should enhance angling opportunities. The public has expressed an interest in maintaining recreational fishing opportunities for introduced trout such as rainbow and brook trout in this area. The desire to maintain these recreational fisheries will need to be balanced with the need to reintroduce CRCT to portions of its historic range. The recent creation of several reservoirs in this area should help to provide recreational fishing opportunities for introduced trout that are not in direct conflict with the goals of the CRCT conservation agreements.

Catostomid and Cyprinid Fishes

For various reasons, the viability of native Catostomid and Cyprinid populations have received little attention within the Muddy Creek and Little Snake River watersheds. Work has recently been initiated to investigate the distribution, habitat requirements, and life history of the bluehead sucker, flannelmouth sucker, mountain sucker, roundtail chub, and speckled dace within the Muddy Creek watershed. It is the intention of these distribution and life history investigations to provide answers to several questions that are key to the proactive development of habitat suitability criteria and conservation strategies for bluehead sucker, flannelmouth sucker, and roundtail chub both within the Muddy Creek watershed and range-wide. These questions include:

- What is the current distribution of the native fishes within the Muddy Creek watershed? Obtaining baseline distribution data is preliminary to conducting life history investigations.
- What are the characteristics of the fish community within which these species reside? Initial sampling has indicated that introduced fishes dominate many of the fish communities of the Muddy Creek watershed. If this proves to be common in the Muddy Creek watershed, the native fishes would be susceptible to replacement by and hybridization with introduced fishes.
- What types of movements are exhibited by these fishes within the Muddy Creek watershed? Research in other areas has indicated that Catostomid species are often highly migratory, moving long distances between wintering habitats and spawning habitats. The ability of these fishes to navigate instream structures of differing design and size is unknown. The ability to navigate instream structures and complete migrations may be important to the completion of their life cycle.
- What habitats are adult and juvenile fishes using respectively? In order to effectively manage the habitats of these native fishes, it will be necessary to develop habitat suitability criteria.
- Are there any habitats, habitat variables, or events that would favor native species over introduced species? Native fishes have been shown to respond positively to natural hydrography, allowing them to fend off introduced species, while the flattened hydrograph, diminished seasonal fluctuations in water temperature and sediment load, and greater average water temperatures resulting from impoundment may increase the competitive advantage of introduced fishes over native fishes (Rinne and Stefferud 1997).
- Are these fishes using habitats outside of the Muddy Creek watershed? Preliminary results of fish trap monitoring at the mouth of Muddy Creek have indicated that both flannelmouth sucker and bluehead sucker are migrating into Muddy Creek from the Little Snake River. The degree to which other species utilize the Little Snake River is yet unknown.

- To what extent is hybridization contributing to population declines? The potential for these fishes to hybridize with introduced species exists within the Muddy Creek watershed. This potential may be strongest among the Catostomid fishes. Samples have been taken and will be analyzed to determine if hybridization has occurred or if pure populations of these fishes remain.

Conservation planning has recently been initiated for the roundtail chub, bluehead sucker, and flannelmouth sucker. A range-wide conservation agreement and strategy for these three species is currently in draft form. This effort has emphasized the collection and integration of information in order to develop conservation actions. By collecting information in the Muddy Creek watershed pertaining to the distribution, habitat requirements, and life history of native Catostomid and Cyprinid fishes, it will be possible to provide site-specific information for conservation planning, and develop strategies to restore the function of aquatic ecosystems.

Coalbed methane development has recently begun in the Muddy Creek watershed (picture 85-1). This development is in the vicinity of sites known to harbor roundtail chub, bluehead sucker, and flannelmouth sucker. The potential impacts to these fishes from surface disturbances, water discharges, and changes to the natural hydrography will need to be considered when developing alternatives during preparation of environmental assessments and environmental impact statements.

3) Current Conditions:

<u>Salmonid Fishes</u>

Colorado River Cutthroat Trout

In September of 2001, the CRCT was reintroduced to approximately 11 miles of its native range in Littlefield Creek (Muddy Creek watershed) (pictures 85-2, 85-3). Pure populations of CRCT can also currently be found in portions of Dirtyman Creek and Hell Canyon Creek within the Little Snake River watershed, as well as many streams draining the MBNF. Within the Muddy Creek watershed, plans are in place to restore CRCT to approximately 20 miles of upper Muddy Creek within the next three to four years. This will connect Littlefield and Muddy Creeks and expand both the range and stability of CRCT populations within the watershed.

The suitability of habitat conditions in the Muddy Creek and Little Snake River watersheds for CRCT has not been fully determined. An inventory was conducted for the upper Muddy Creek watershed in 1994. Hoffman (1995) found there to be a lack of large woody debris, other large structural elements, and pool habitat suitable for adult CRCT. Stream temperatures in these mid-elevation streams are potentially limiting to CRCT. Maximum water temperatures in the Muddy Creek watershed regularly exceeded 70°F during the summer months of 1993 and 1994 (Hoffman 1995). Stream temperature trend should be down due to increasing encroachment of sedges and grasses into the channels in the past eight years. Many of the streams within the Muddy Creek and Little Snake River watershed have suffered from past periods of vertical instability. This instability has resulted in wider and shallower stream channels that offer little or no shading and a lack of habitat complexity.

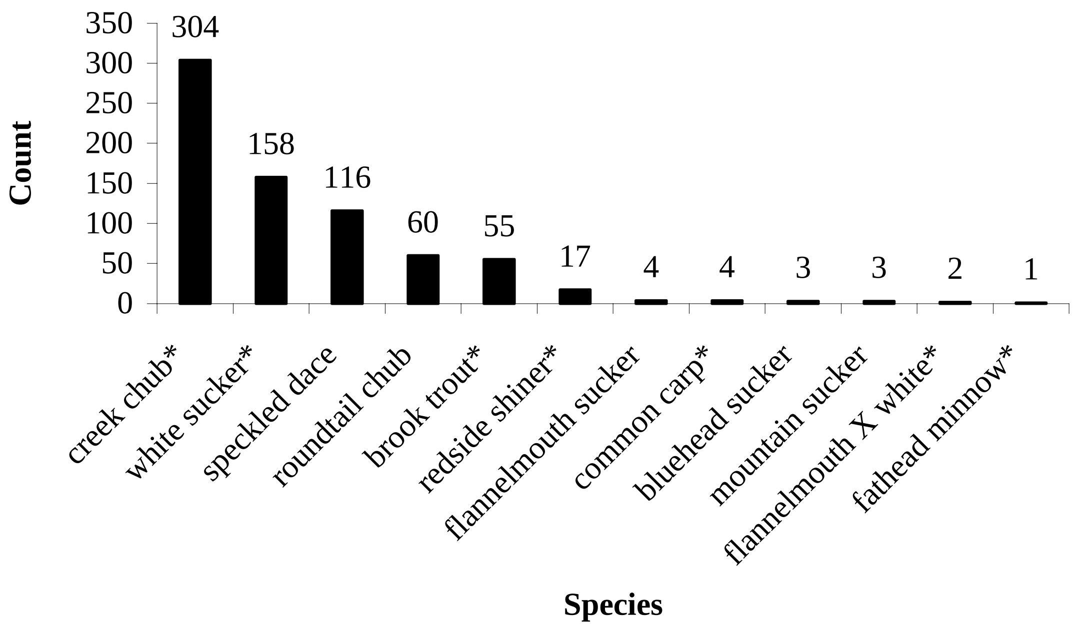
In addition to the CRCT, there are several introduced salmonid species within the Muddy Creek and Little Snake River watershed that provide recreational fishing opportunities. These species include brook trout, rainbow trout, and brown trout. These fishes have been stocked in many reservoirs throughout these watersheds and can also be found in many of the perennial streams.

<u>Catostomid and Cyprinid Fishes</u>

In 2001, a systematic fish population inventory of the Muddy Creek watershed was initiated as the first step in defining the current distribution of sensitive non-game fishes, the life history of those fishes, and the stability of native fish communities. To date, 18 of 65 inventories have been completed. Though inferences made based on these initial inventories may not be representative of the Muddy Creek watershed, many of the sites inventoried to date have been dominated by introduced fishes (Graph #2).

In addition to conducting fish population inventories, a fish trap was placed at the mouth of Muddy Creek in April 2002 to monitor the movement of fish into Muddy Creek from the Little Snake River. It was found that flannelmouth suckers and bluehead suckers were migrating into Muddy Creek from the Little Snake River. It is not known where these fishes were migrating to, but it is likely that they were attempting to utilize Muddy Creek or one of its tributaries as spawning habitat. It remains unclear whether these fishes were able to reach suitable spawning habitats.

The most current information pertaining to the distribution of fishes within the Little Snake River watershed can be found in Oberholtzer (1987). To date there have been no inventories of stream habitat conditions as they pertain to Cyprinid or Catostomid fishes in these watersheds.



Graph #2. Composition of fish communities sampled within the Muddy Creek watershed during 2001.
* Indicates introduced species.

4) Reference Conditions:

<u>Salmonid Fishes</u>

Colorado River Cutthroat Trout

The distribution and abundance of CRCT have declined from historical levels (Young 1995, Martinez 1988, Binns 1977, Behnke and Zarn 1976). It has been stated that CRCT currently occupy less than 1% of their historical range (Behnke 1979). Within the Muddy Creek watershed, historical accounts of "speckled trout" date to 1850. Reference was also made to beaver dams at short intervals in the vicinity of the "speckled trout."

<u>Catostomid and Cyprinid Fishes</u>

By comparing the results of surveys completed in 1965 by Dr. George T. Baxter with those completed during 1995-1996, Wheeler (1987) was able to determine distributional changes of fishes in Wyoming west of the Continental Divide. Each of the species native to the Muddy Creek and Little Snake River watersheds were found to be in various stages of decline throughout their range in Wyoming. Three of these species, the bluehead sucker, flannelmouth sucker, and roundtail chub, were restricted to a fraction of their native ranges in Wyoming. Both the mountain sucker and speckled dace showed early signs of decline. The non-native white sucker had greatly increased its geographic range in western Wyoming between 1965 and 1996.

5) Synthesis and Interpretation:

After suffering from periods of instability, habitat conditions within the upper Muddy Creek watershed continue to improve as the result of rotational grazing systems, barrier removal, spawning habitat enhancement, and headcut stabilization. The implementation of rotational grazing systems in the Little Snake River watershed has also resulted in marked improvements in stream habitat conditions. Though much time and effort has been spent on the restoration of CRCT habitats, this work can be viewed as ongoing. There is still work to be done to connect habitats by removing barriers to fish movement. There is also work to be done to increase the amount of woody vegetation in these streams in order to increase stream shading and habitat complexity. The management of streams in the upper Muddy Creek for late-successional habitats would improve their suitability for CRCT. The suitability of spawning and rearing habitats has not yet been determined, as reproduction has not yet been documented. Finding a balance between native and non-native fishing opportunities will continue to be a challenge, as they are often mutually exclusive.

In many cases it is not currently possible to assess the suitability of habitats in the Muddy Creek or Little Snake River watersheds for Catostomid and Cyprinid fishes. Knowledge of the life history of these fishes as observed in other areas can provide some direction for making land management decisions. However, current investigations into the distribution, habitat requirements, and life history of these fishes within the Muddy Creek watershed will allow the development of site-specific conservation strategies. This information will also be useful in assessing impacts related to development activities. Work by Wheeler (1997) showed that these fishes have witnessed dramatic reductions in range since 1965. Of the greatest concern were the roundtail chub, bluehead sucker, and flannelmouth sucker. Both mountain sucker and speckled dace appeared to be in the early stages of decline.

6) Recommendations:

The improved management of riparian habitats and successful reintroduction of Colorado River Cutthroat Trout into upper Muddy Creek, as well as other cold water fisheries that exist within the watershed, indicate both an upward trend and meeting Standard #4 for fisheries. However, many other sites that should support fisheries, currently do not. Standard #4 for fisheries is not being met on streams, which currently fail Standard #2 – Riparian/Wetland Health and/or Standard #5 – Water Quality. There are also sites that are rated in proper functioning condition, but due to the lack of overhead cover (stream shading) exceed temperature requirements for some fish species and won't support them. However, these sites have not yet been defined. Due to the lack of credible data on the status of Catostomid and Cyprinid fishes in the watershed, whether Standard #4 is being met for these species is unknown.

Now that CRCT have been reintroduced to Littlefield Creek, monitoring their success will be critical. The reintroduction of CRCT into upper Muddy Creek should receive a high priority in coming years in order to connect two populations and work toward establishing a metapopulation in the upper Muddy Creek watershed. Historical range of CRCT in this watershed consisted of the upper Muddy Creek watershed including Littlefield Creek and McKinney Creek downstream to Alamosa Gulch. Opportunities to add additional stream miles to this metapopulation in order to increase its long-term viability should be pursued. CRCT habitats should remain a high priority for conservation actions such as barrier removal and habitat enhancement. The management of stream habitat beyond proper functioning conditions to a later successional stage should be considered for areas that have been identified for CRCT reintroduction. Opportunities to monitor movements of CRCT should be pursued in the upper Muddy Creek watershed. This would help to define habitat use and the importance of connectivity. Existing populations of CRCT and their habitats within the Little Snake River watershed in Hell Canyon Creek and Dirtyman Creek should be monitored to ensure that habitat conditions remain suitable. Balancing conservation actions for CRCT with ongoing land uses will continue to be crucial. Additionally, the maintenance of recreational fishing opportunities for rainbow and brook trout should be a high priority where they are not in conflict with CRCT.

Investigations into the distribution, habitat use, and life history of native Catostomid and Cyprinid fishes in the Muddy Creek watershed should be continued. This research will provide managers with the information necessary to make informed land management decisions and develop conservation strategies that will help to reduce or eliminate the need to list these fish under the Endangered Species Act. Future work should be targeted at the native fish assemblage of the Little Snake River watershed. Specific information needs include the distribution and movements of fishes within the watershed.

The native fish of the Colorado River basin have witnessed dramatic population declines. Many of these fishes are nearing extinction and some are already gone. Neither legislation nor determined attempts at conservation have succeeded at reversing this trend. Competition and hybridization with alien species, as well as changes to the natural habitats of these fishes are the principal factors causing this trend (Rinne and Minckley 1991). The conservation of these fishes will be contingent on their recognition as important indicators of ecosystem function and sustainability. The importance of conserving native species, and limiting the number of species listed under the Endangered Species Act should be considered when making land management decisions.

Continue to implement or manage using best management practices (BMPs) for livestock grazing. This primarily means controlling the season, duration, and distribution of livestock use to meet desired resource objectives for both riparian and upland habitats. Objectives more specific to fisheries should include restoring riparian function while reducing stream width/depth ratios and increasing the abundance and cover of riparian shrubs and trees to improve bank stability and stream shading. Methods used to improve fish habitat conditions, should be chosen based on the life history requirements of the fish species present or of concern.

Continue to eliminate or control active head-cuts, along with the necessary livestock management, in order to promote long-term, vegetative stabilization of these sites. Reduce soil erosion entering streams from adjacent, eroding banks and side-hills. Continue exploring options like supplying aspen to beaver, in order to heal and restore riparian habitat (picture 88-1).

Remove or modify, where needed, barriers to fish migrations. Small drop structures may still be used to stabilize banks, catch sediment and woody debris, raise or maintain water tables, and create pool habitat. Existing structures should be maintained if they are not a barrier to fish movements. Continue to plant riparian species to stabilize banks and increase overhead cover for shading.

Identify and correct problems with improved roads, which affect water flows and contribute soil erosion into streams and reservoirs. Two-track roads are too numerous to deal with as a whole; however, problem areas should identified and fixed or the road should be closed and reclaimed.

Implement vegetation treatments to restore plant communities and to increase base flows in streams to meet fish habitat objectives where appropriate. Promote composition of communities to maximize herbaceous cover and litter, and therefore, minimize surface runoff and soil erosion.

Weeds

1) Characterization:

Weeds, or invasive non-native plants, threaten natural ecosystems and greatly impact natural plant communities throughout the West. Ecologically, these invaders may threaten ecosystems. The reduction of light, water, nutrients, and space available to native species can change the hydrological patterns, soil chemistry, erodibility and may even change fire patterns on a localized basis (NPS ref). These invaders can reduce biodiversity, affect threatened and endangered species, change habitats and natural plant/animal associations, and prevent native species from remaining or encroaching upon a site. Unlike many areas of the West, overall the Rawlins Field Office has a comparatively smaller weed problem than other areas in the Rocky Mountain region. The analysis area is relatively noxious weed free, with just small problem areas. The term ***noxious*** is a legal designation used specifically for plant species that have been determined to be major pests of agricultural ecosystems and are subject, by law, to certain restrictions. The U.S. Department of Agriculture regulates noxious weeds (NPS web). Within the analysis area, noxious species are predominantly found along roadways and other disturbed areas associated with oil and gas development, recreational use, and livestock grazing activities. Road building, development, grazing, fire suppression, and other activities can directly increase weed establishment and/or maintain their presence within the ecosystem.

The main noxious species present within the area are whitetop, saltcedar, houndstongue, musk thistle, and Russian knapweed. Other noxious species include yellow and Dalmation toadflax, plumeless thistle, Canada thistle, spotted knapweed, and burdock. There are also several non-native invasive species present which are normally restricted to disturbed areas. These include halogeton, Russian thistle, bull thistle, begonia dock, henbane, gumweed, annual goosefoot, mullein, and several annual mustards. Halogeton and henbane stand out in this group as being poisonous to livestock.

The following weed descriptions and associated photographs were taken from *Weeds of the West*, the authorization for which is in Appendix E. Whitetop is a deep-rooted perennial up to two feet tall, which reproduces from root segments and seeds (picture 89-1). It occurs on alkaline, disturbed soils along roads and the edge of meadows and irrigation ditches, and is highly competitive with other species. Saltcedar is a deciduous shrub introduced from Eurasia as an ornamental (picture 89-2). In many places it has become naturalized along streams and reservoirs and tends to form monocultures that limit biodiversity. Saltcedar can transpire up to 200 gallons of water per plant each day and can dry up ponds and streams. In addition, it brings large amounts of salt up from the soil and deposits it on the surface, thus rendering adjacent sites uninhabitable by native species. Houndstongue is a biennial that reproduces by seed (picture 89-3). It was also introduced from Europe. Like thistle, it forms a rosette the first year and a reproductive stalk the second year. It us usually found in pastures, roadsides and disturbed habitats. Houndstongue is toxic. Musk thistle is a biennial that was introduced from Europe and western Asia and is now widespread (picture 89-4). It occurs in pasture, range, and forest lands along roads and disturbed areas. In our area it is found between Savery and Battle Mountain. It spreads rapidly, forming dense stands, and can crowd out native forage. Russian knapweed is a poisonous perennial, and can also form dense colonies (picture 89-5). It is a native of Eurasia and is found throughout the West. It spreads by seeds and adventitious roots that can penetrate up to eight feet.

2) Issues and Key Questions:

The area is seeing an expansion of some of these species as new disturbances are continually being created. Appropriate reclamation practices slow the spread of weedy species. The main concern is to keep the noxious weeds from spreading into undisturbed rangeland from the initial sites of introduction along roadsides, well pads, pipelines, livestock water developments, hunter camps, and other disturbed areas. Are there adequate mitigation measures in place to address weed control in high priority development areas, and is enforcement of existing stipulations occurring? In addition, are rules concerning certified hay requirements appropriate for controlling livestock issues? Is livestock management adequate to keep weed species from encroaching into native rangelands? Is more direct action needed, especially in allotments where livestock movements are possibly increasing weed presence? Are high populations of wild horses reducing conditions of native rangelands, making them more susceptible to invasion by weed species? In the isolated cases where recreation is a factor in weed establishment, are adequate measures being taken to address this problem?

3) Current Conditions:

Weed locations are primarily restricted to disturbed areas associated with oil and gas development, recreational use, and livestock grazing activities such as water developments. Most noxious weed locations associated with manmade disturbances are being treated either by lease/ROW holders, Weed and Pest, or

BLM. There are only a few areas where the noxious weeds are spread throughout the native rangeland. These areas are being treated to contain the weeds where they are and try to avoid having them spread elsewhere by vehicle, equipment, or animal movements. Most improved roadways are being treated for noxious weeds. Oil and gas activity and recreation areas are being treated for noxious weeds and are the main source of weed introduction and spread. The increase in oil and gas activity will result in expansion of some of these species as development-related disturbance continues.

As stated earlier, the principal noxious species found within the analysis area include houndstongue, musk thistle, Russian knapweed, whitetop, and saltcedar. Houndstongue is primarily in the lower Savery Creek drainage, including Loco Creek (picture 90-1). It is a biennial plant, with a small sticky seed, which sticks to anything it touches and, therefore, is easily moved around by animals and people. Improved livestock management practices to increase native plant cover, along with chemicals and hand pulling are used to control this species. It is also showing up along disturbed roadsides. Musk thistle occurs in meadows and along highways and is spreading into adjacent native rangelands. It is being treated both chemically and biologically through the release of beetles whose larvae eat the developing seeds or mine out the roots. Russian knapweed and whitetop primarily occur in disturbed areas along roads in small spots. The knapweed is aggressively treated. At this time, saltcedar is not yet as significant a problem as it is in other parts of the state and the West. Saltcedar, or tamarisk, occurs along ephemeral drainages like Sand Creek and Shell Creek, in spots along Muddy Creek, and around reservoirs. It has not received much attention yet, but that is changing as it replaces native willows in riparian habitat. Spring livestock use appears to offer some control. The other common specie of interest is Canada thistle, which occurs in and along riparian habitat, and in some cases along roads. As long as the riparian habitat is being properly managed, Canada thistle is not expanding and just occupies the niche between the riparian and upland habitats. It is being treated along roads. Other species, which occur in very isolated patches, include spotted knapweed (along the highway ROW), yellow and Dalmation toadflax, plumeless thistle and burdock. Other noxious species in the watershed occur only on private lands. These are leafy spurge and perennial pepperweed. These species are currently associated with the Little Snake River corridor, but the spurge can occur in all habitats and will need to be closely monitored.

The two invasive, non-native species of concern are halogeton and black henbane. Halogeton is widespread throughout the oil and gas areas, lining roadways and in some cases dominating inadequately reclaimed sites (picture 90-2). It is also invading into nearby native rangelands on shale and saline upland sites in the Sand Creek allotment from untreated oil and gas roads. Halogeton is poisonous and in the past caused sheep losses due to its prevalence in certain areas. Since the sheep numbers have declined, fewer losses due to halogeton poisoning have occurred. However, it is still a high priority for control along trail routes and in the remaining sheep allotments. It often provides lush forage along roads due to the late summer flowering habit and added moisture from road runoff (picture 90-3). Halogeton has also been known to kill cattle. Although it is a stipulation on oil and gas APDs and ROWs to treat and control weed species, in many cases this is not occurring, particularly in the winter sheep allotments west of Highway 789 (picture 90-4). Black henbane is also poisonous and can expand rapidly in disturbed areas, so it is targeted for treatment, primarily along disturbed roads (picture 90-5). Most non-native invasive species, including halogeton, are not treated unless they are interfering with reclamation of disturbances or are a fire hazard around well locations.

Specific areas within the analysis area with noxious weeds and the status of treatment are as follows:

- ✓ Powder Rim Road, by Powder Mountain: henbane—being treated
- ✓ Moonshine Springs: saltcedar—been treated
- ✓ Road paralleling Powder Rim to north: Russian knapweed, one patch—being treated
- ✓ Hangout Road: houndstongue and henbane—being treated, but still expanding
- ✓ Sand Creek & Willow Creek: saltcedar—expanding, not treated
- ✓ Robber Gulch/Blue Gap area Reservoirs: saltcedar—expanding, being treated
- ✓ Wamsutter/Dad road (Carbon County 701): whitetop—mostly not treated
- ✓ Standard Road, most gas field roads: whitetop—mostly not treated; isolated patches of Russian knapweed and saltcedar—treated as found

- ✓ North Barrel Springs, Barrel Springs, South Barrel Springs, Shallow Creek, Windmill Draw: whitetop along roads and down drainages in rangeland—mostly not treated except some along roads
- ✓ Highway 789: scattered patches of Russian and potted knapweeds in ROW—treated as found
- ✓ Gas field in Smiley Draw and along Wild Horse Road 3309: houndstongue, bull thistle, Russian knapweed—being treated
- ✓ Highway 70 ROW: musk thistle, scattered small patches of Dalmatian toadflax, whitetop, perennial pepperweed--treated as found
- ✓ Baggs/Dixon/Savery area: perennial pepperweed, leafy spurge, musk thistle mostly private lands—some treatments are ongoing
- ✓ Oil field north of Savery & Carbon county 501: henbane, houndstongue, yellow toadflax, whitetop—County ROW treated only
- ✓ Savery Creek/Loco Creek/Carbon County 561: houndstongue, bull thistle, plumeless thistle, mullein—Some areas treated along Loco Creek, most private land is not treated
- ✓ Battle Creek south of Battle Mountain: houndstongue, bull thistle, musk thistle, burdock, whitetop—some areas started treatment 2002, not completely inventoried
- ✓ Rendle Rim Road/Canary Grove 3308/McCarty Canyon Carbon County 503—mostly ROW: henbane, whitetop, houndstongue—areas treated as found

A significant portion of the watershed has not been inventoried for weeds, but it is assumed that unless there are disturbances, there probably are not any weedy species present. General range condition is good to excellent, with good vigor and cover of native species. Most non-native invasive species are not treated unless they are interfering with reclamation of disturbance. As native vegetation is reestablished, many of the non-native invasive species will be crowded out. The species of long-term concern within the assessment area are the noxious species and halogeton.

4) Reference Conditions:

"Early European settlers in North America inadvertently brought weed seeds with them, perhaps in the hay they brought for their animals or in the dirt they used as ballast for their ships, or even in their clothes or bedding. Some activities, such as clearing the land, opened up niches that created places for weeds to grow. Settlers also purposely brought plants from their 'home country' to reseed areas, make dye for clothing and use as ornamental plants. Some of these non-native plants became invasive, reducing the diversity and quantity of native plants. Weeds are continuing to spread rapidly in many areas across the country. Weeds spread to an estimated 4,000 acres each day on public lands managed by the BLM and Forest Service" (BLM Noxious Weed Webpage).

For the most part, this assessment area has been weed-free until relatively recent disturbances by man over the past 50 or 60 years. Petroleum development, especially in the western portion, has greatly increased noxious and invasive non-native species introduction. The advent of motorized travel and subsequent increasing miles of road have resulted in the spread of weedy species. Settlers along riparian corridors have historically impacted these areas by clearing the land, irrigation, and overall human presence-associated disturbances. These areas also tended to have higher concentrations of livestock, especially historically, when riparian systems were "sacrifice areas" and did not receive the management attention that they do currently.

5) Syntheses and Interpretation:

The highest priorities for treatment are the aggressive weed species, such as musk thistle, Russian knapweed, and leafy spurge, which are able to spread throughout stable native plant communities. These are promptly treated and monitored, and are not specifically related to livestock grazing. Where livestock grazing is contributing to the invasion or expansion of weed species, then management must be changed, as in what happened in the Morgan Boyer allotment containing Loco Creek.

Due to BLM's multiple use philosophy, oil and gas development will continue to occur and provide increasing areas for sites of additional weed establishment (picture 91-1). Mitigative practices to control these noxious weeds will continue to be necessary. In addition, the presence of roads and their associated maintenance will also continue to provide additional weed areas. Some annual weed species are initially beneficial in terms of providing cover on reclaimed pads and pipelines that trap snow, reduce runoff, and shade young perennial grasses. However, these species should not continue to be the dominant species several years and beyond after reclamation has occurred.

Some areas have weed problems that are spread by animals, people and vehicles. The highest priority areas related to livestock grazing include Baggs, Dixon, Savery, and eastward. The species involved are musk thistle, Canada thistle, houndstongue, leafy spurge, perennial pepperweed, plumeless thistle, and burdock. These are either eaten or physically spread by livestock movements.

6) Recommendations:

Due to the existing good condition of native vegetation and the weed treatment program in place to control and/or eradicate weed problem areas as they are identified, it is determined that the majority of Upper Muddy Creek watershed is meeting Standard #4 with respect to weeds. There are no known areas of noxious weeds that are rapidly expanding and are not being treated. Although saltcedar is not yet being treated on a broad scale, it does not appear to be rapidly spreading to new locations. The few locations that do not meet Standard #4-Weeds are sites containing halogeton in Sand Creek allotment where the weed is invading native rangelands as a result of oil and gas road development and is not being treated. These areas affect approximately 50 acres. The following recommendations would expand upon the success already achieved and help to meet desired resource conditions in the future.

Continue inventory and treatment efforts in the area to identify and contain or eradicate noxious weeds. Continue to work with ROW/lease holders in their treatment of weedy species, as well as work with landowners on concurrent treatments with private lands. Enforcement of stipulations on APDs/ROWs to control weeds must occur. Most importantly, reduce disturbance due to development as much as possible, thereby reducing weed spread potential.

Continue to implement "best management practices" for livestock grazing to maintain or improve the health of rangeland plant communities so that fewer opportunities for weed invasion or expansion exist.

The BLM must maintain wild horse populations within appropriate management levels. Current high numbers of wild horses reduce plant vigor and cover, and may lead to expansion of weed species in native rangelands within the Adobe Town herd management area.

Identify non-native weed species that need to be treated throughout the assessment area. Although they are not a major focus for treatment, they can be a significant problem within localized areas.

Address road maintenance equipment movement procedures to address the spread of noxious weeds from/to other areas. Procedures such as cleaning equipment from one site to the next, minimizing disturbance of native vegetation, and prompt reseeding after construction are important.

Continue to support a certified weed-free hay program for those recreational and livestock grazing users that bring in livestock and hay from other areas. In addition, there may be a need to address livestock movement from pasture to pasture to curtail weed spread within an allotment. There may also be a need to monitor livestock shipped into the area from other states, a potential source of noxious weeds.

Continue to support a certified weed-free seed and mulch program for reclamation of disturbed lands.

STANDARD 5 – WATER QUALITY

Water quality meets state standards.

1) Characterization:

In 1972, the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act, was signed into law. Its purpose is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The Act gave the Environmental Protection Agency the authority to implement pollution control programs through partnerships with each individual state. Provisions for establishing water quality standards were included in the Clean Water Act, as amended, and in the Wyoming Environmental Quality Act, as amended. Regulations are found in Part 40 of the Code of Federal Regulations and in Wyoming's Water Quality Rules and Regulations. The latter regulations contain Quality Standards for Wyoming Surface Waters.

The State of Wyoming has surface water quality standards in place for streams rated from class I to IV. Each rating class has specific numeric and narrative water quality standards. Class I waters of the State are waters where no additional water quality degradation will be allowed. Classes II through IV waters are differentiated based on their ability to support fish and other human and wildlife uses. In general, Class II waters support fish populations, Class III waters are non-game fisheries, and Class IV waters do not have the potential to support fish, but have the potential to support other aquatic life. There are no Class I waters in the assessment area.

Water bodies that do not meet their designated beneficial uses are placed on the State 303(d) list for impaired water quality, with factors identified that contribute to the impairment. The following stream segments in the Upper Colorado River basin, which occur on BLM-administered public land, are listed as water bodies with threats on the current Wyoming State 303(d) list due to physical degradation, and for some excessive sediment, temperature, Total Dissolved Solids (TDS) and/or nutrients:

- Loco Creek (west fork), above the confluence with the main fork, Savery Creek drainage
- McKinney Creek, from confluence with Eagle Creek down to Muddy Creek
- Muddy Creek, from confluence with Littlefield Creek down to confluence with Alamosa Gulch
- Muddy Creek, from confluence with Barrel Springs Draw down to confluence with Little Snake River

The first three sites have livestock grazing identified as an impairment factor and are identified as Class II waters, although they currently do not support cold water fisheries. The last site on lower Muddy Creek has both livestock grazing and oil and gas development identified as impairment factors and is identified as a Class III water. Non-game fish species use it on a seasonal basis.

2) Issues and Key Questions:

Water quality usually relates to healthy riparian and upland habitats. Degradation of either or both of these habitats will lead to impairment. For the streams listed above, historic/current duration and season of livestock use are too long, resulting in streams that don't meet proper functioning condition or desired future resource condition. Upland cover and watershed condition is generally good. In terms of oil and gas development being listed as an impairment factor, this does not have to do with degradation of riparian or upland habitats along Muddy Creek or in the Barrel Springs Draw watershed. Instead, this is due to accelerated erosion contributed by the oil and gas industry through soil-disturbing activities and road-induced alteration of surface hydrology. What best management practices (BMPs) need to be developed or further refined in order to remove these streams from the state 303(d) list or at least removed as the cause of impairment? How can road designs be improved to minimize impacts to surface water flows and reduce soil erosion caused by roads or other surface-disturbing activities and reclamation practices?

3) Current Conditions:

Water quality is difficult and expensive to directly monitor, with changes often fluctuating and more closely corresponding with climatic events than due to short-term changes in management and condition. Grab samples and some gauging station data have been collected, but they have not been consolidated for this document (picture 94-1). The best information is indirect data that relates to water quality, such as bank cover, species composition, and width/depth ratios.

Water quality trends in the 303(d) listed streams are quite variable, depending on current impacts and management.

- Loco Creek (west fork) originates for the most part on private lands before entering public lands in the West Loco and Morgan-Boyer allotments. This stream is slowly improving due to livestock management. Principal indicators are increasing species composition of perennial deep-rooted sedges and willows and reduced width/depth ratios. The five permittees using public lands are supportive of livestock management BMPs and have contributed in both livestock management and range improvements to improve this watershed. The primary action still necessary to meet this standard is completing the West Loco prescribed burn in order to remove dense sagebrush stands, improve livestock distribution, improve ground cover, and increase late-season stream flows.

- McKinney Creek flowing through the Bolten/Pine Grove allotment is improving due to ongoing livestock management and range improvements. Principal indicators are increasing bank cover, increasing species composition of perennial deep-rooted sedges and willows and reduced width/depth ratios. The single permittee is involved in two separate watershed projects, is strongly supportive of implementing and following any necessary changes in livestock monitoring, and has contributed extensively to both range improvement and monitoring efforts. The primary actions still needing to occur are shrub treatments to remove or reduce dense sagebrush, improve livestock distribution, improve ground cover, and increase late-season stream flows.

- Lower McKinney Creek and Muddy Creek from the confluence with Littlefield Creek down to the confluence with Alamosa Gulch, is in the Sulphur Springs allotment (picture 94-2). Water quality from the Osborne shipping pasture upstream is improving due to livestock management with fenced pastures, gradient control structures, and vegetative plantings. Water quality in McKinney Creek and Muddy Creek below the shipping pasture is slowly improving or static. The pastures in this portion of the allotment are mostly based on topography. Several short drift fences are planned, but there is a reluctance to have to maintain fences in rough terrain and increase impacts to movements of big game species. Principal indicators of improvement are increasing bank cover, increasing species composition of perennial deep-rooted sedges and willows, and reduced width/depth ratios. The single permittee is supportive of livestock BMPs and has contributed in both livestock management and range improvements to improve this watershed. The primary action still needing to occur is completion or extension of four drift fences to control livestock duration and season of use along streams.

- Muddy Creek, from the confluence of Barrel Springs Draw down to the confluence with the Little Snake River passes through six allotments and mostly private land near Baggs. Water quality is improving or not being impacted by livestock on five allotments, which have intensive management to control livestock season or duration of use. Principal indicators are bank cover, increasing composition of perennial deep-rooted grasses, sedges and willows, and reduced width/depth ratios. Water quality on the sixth allotment is static. Cherokee allotment is an 80,000 acre allotment with only one small pasture, nine permittees, and a nine-month season of use. An allotment management plan is currently being implemented to control livestock season and duration of use (along with other BMPs) which should help to improve water quality and remove livestock grazing as an impairment factor on the 303(d) list. However, impacts from roads on surface hydrology, primarily due to oil and gas development in the entire Muddy Creek watershed, will still need to be addressed in order to significantly improve water quality.

4) Reference Conditions:

The principal reference conditions are the historic accounts by Stansbury and Bryan in the 1850s about catching speckled trout in Muddy Creek from its confluence with Alamosa Gulch upstream to the headwaters. Other accounts also refer to catching trout in the Savery and Battle Creek drainages. The streams' ability to support trout imply that water quality conditions were similar to the Class II standard.

5) Synthesis and Interpretations:

Water quality issues in the Upper Colorado River basin relate to sediment and salinity delivery into perennial waters, which are primarily influenced by non-point impacts to vegetation from livestock grazing, roads, and other soil disturbance activities. Moderate amounts of natural erosion are produced due to local soils, vegetative cover, and climate conditions. Muddy Creek received its name in the early 1800s for a reason. However, impacts from grazing and roads have led to accelerated erosion and impairment of function in some creeks within the region.

The principal focus for improving water quality has been livestock management practices. In 1980, most allotments were used for long periods of time without pastures and little or no rotation. This practice, which had been encouraged by the range profession and agencies of the time, was based on the belief that light to moderate stocking rates and good distribution were the best prescription for range management. However, key species and key areas like riparian habitat were not treated well with this type of management. The emphasis now is to control duration and season of use more than intensity of use, in order to provide some growing season rest to maintain plant vigor in all habitats. A variety of techniques are used to accomplish this, referred to as BMPs. They include the use of pastures and herding, upland water developments and shrub treatments, and timing of use. The benefits of using BMPs has already been documented and discussed in the previous sections for other rangeland standards, particularly improvement in bank cover, species composition, and width/depth ratios. Another indirect form of monitoring water quality is through the use of macro-invertebrates.

Macro-invertebrates are the "bugs" that live in streams; many of them are larval stages of flying insects, such as mayflies, stoneflies, and dragonflies. Different species require specific types and quality of habitat to survive and flourish. The diversity and abundance of different "bugs" give a good indication of not only water quality, but the health of the entire watershed. Monitoring has occurred annually from 1994-2001 in the form of Benthic Macroinvertebrate sampling (picture 95-1). Using the BMPs discussed above, several streams have already been removed from the Wyoming 303(d) list of impaired streams, including Littlefield Creek, McKinney Creek above the confluence with Eagle Creek, Muddy Creek above the confluence with Littlefield Creek, and the main branch of Loco Creek. In the case of Littlefield Creek, the following macro-invertebrate indices showed an upward trend, indicating an improving trend in water quality. The Hilsenhoff Biotic Index indicates a drop in nutrient enrichment/sediment load from 1996 to the present. The Shannon Diversity Index indicates an increase in the number of distinct taxa and their relative abundance. And the Dominant Family Percent Contribution has dropped in most cases, and in those cases where it rose it was for a family requiring higher water quality conditions. Karr and Chu (1998) identified ten biologic metrics, which best demonstrate human disturbances on aquatic insect communities. From 1994 to 2001, seven of the ten parameters quantitatively analyzed from Loco Creek show a positive upward trend in improvement of the biological integrity of Loco Creek. The other three parameters have remained stable or slightly positive.

Other monitored trends, or in some cases observations, include lower peak stream temperatures/higher oxygen levels, lower turbidity, and increased base flow levels – even in dry years (picture 95-2). These are all indicators of improving trends in water quality conditions.

6) Recommendations:

Within the assessment area, water quality impairment has not been identified by the State of Wyoming for the majority of the area. The following stream segments in the Upper Colorado River basin, which occur on BLM-administered public land, are listed as threatened on the current Wyoming State 303(d) list of impaired waters:

- Loco Creek (west fork), above the confluence with the main fork, Savery Creek drainage
- McKinney Creek, from confluence with Eagle Creek down to Muddy Creek
- Muddy Creek, from confluence with Littlefield Creek down to confluence with Alamosa Gulch
- Muddy Creek, from confluence with Barrel Springs Draw down to confluence with Little Snake River

The first three sites have livestock grazing identified as an impairment factor. The last site on lower Muddy Creek has both livestock grazing and oil and gas development identified as impairment factors. Although specific compliance for the remaining segments is unknown, nothing within available data indicates this Standard is not being met.

Continue to implement or refine BMPs for livestock grazing, which promote perennial vegetation to stabilize streambanks and improve cover and litter on uplands. Season and duration of use are the principal factors in considering management changes to address this standard.

Identify and correct existing road problems that alter surface water flows and result in accelerated erosion. Incorporate measures into new projects and environmental assessments, which will mitigate alterations to surface water flows.

Promote mixed-age shrub and woodland communities with higher proportions of young and middle-aged stands, which have greater amounts of herbaceous cover to reduce runoff and soil erosion and increase infiltration and ground water recharge.

STANDARD 6- AIR QUALITY

Air Quality Meets State Standards.

1) Characterization:

Air quality within the field office cannot be easily documented, since monitoring data has not been gathered for the most part, except for site-specific projects. Air quality regulations consist of the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) increments. The NAAQS limit the amount of specific pollutants allowed in the atmosphere. All BLM-administered lands are classified PSD Class II, which means that moderate, controlled growth can take place. However, adjacent to this field office is a high priority airshed for the Mt. Zirkel Wilderness Area.

In 1999, EPA issued regulations to address regional haze, which are visibility impaired areas caused by numerous sources located across a wide geographical range. Visibility impairment happens when light is scattered or absorbed by particles and gases in the atmosphere. It is most easily described as haze that obscures the clarity, color, texture, and form of what we see (NAQETR, 1999).

2) Issues and Key Questions:

Several different factors can greatly affect air quality within this analysis area, but most are unrelated to livestock grazing. Oil and gas development and coal mining produce the largest and most continuous amounts of pollutants in the air. The pollutants come directly from power plants and coal mine emissions, areas of production such as well heads in burn-off operations, and other associated activities. Vehicle traffic contributes pollutants through the combustion of fossil fuels. Where interstates or highways are present, more motor vehicle traffic will result in increased levels of these pollutants. In less developed areas, such as along two-tracks these levels of pollutants will be greatly reduced due to less traffic (pictures 97-1, 97-2). Oil and gas (and other uses) traffic along these dirt roads also affects air quality over the short term, especially during dry conditions. How can we reduce pollutants that enter the air at their source, and also address associated air quality issues such as dust abatement from vehicular travel?

Prescribed burns and wildfires affect air quality in a localized area for a short period of time. Prescribed burns are implemented in coordination with and permitted by the Wyoming Department of Environmental Quality. Most are planned in a way to minimize impacts to more-populated areas. Large-scale fires are becoming much more common due to decades of fire suppression. If fuel breaks aren't created occasionally by prior burned areas, could we be looking at larger wildfires with associated air quality issues?

Livestock grazing may slightly affect air quality within the field office by possibly reducing vegetative cover in certain areas, increasing areas of bare ground where trailing occurs, causing short-term dust pollution when herded or moving, and production of methane gas through digestion. Is the presence of livestock a serious concern with respect to air quality?

3) Current Conditions:

Overall air quality is good within the area, which is due in large part to the presence of reliable winds. According to a letter received from the Wyoming Department of Environmental Quality there are no air quality criteria pollutant non-attainment areas for either state or federal standards within the boundaries of the Rawlins Field Office. Lichens (an important air quality indicator) are prevalent throughout the assessment area and the field office.

Current annual average conditions range from 18-40 miles in the rural portions of the eastern United States to 35-90 miles in the rural western portions. On an average basis, they are estimated at approximately 80-90 miles in the east and up to 140 miles in the west (NAQETR, 1999). Three figures (1, 2, and 3) from this report document the clearest, middle, and haziest days across the country. On a local basis, visibility as reported from the Rawlins airport is on average 60 miles. On days that are hazy due to drift smoke this visibility can be less than 10 miles.

Oil and gas development and the associated roads and traffic have impacts on local air quality. Some roads have been surfaced to reduce dust levels, but there is still much that should be done. In high development areas, roadside vegetation is caked with dirt, and in the winter the snow shows the movement of dirt particles. Dry soil conditions exacerbate the problem, so in the summer dust is increased. This not only affects air quality but also public safety, as visibility when traveling by vehicle can be severely hindered. In many cases headlights must be turned on to alert others of vehicles within the area.

Short-term impacts from prescribed burning and/or wildfires can also impact air quality. There are usually only a few prescribed burns in this area conducted mainly in the fall. The burns usually only take a few days to implement and generally require winds in the burn plan prescription. If they are close to communities, the burn plan tries to mitigate short-term impacts to air quality.

No large wildfires have burned in the local area, the largest has been less than 3,000 acres. The majority of wildfires are less than 10 acres. Therefore, local wildfires have as minimal an impact on air quality as do prescribed burns. However, large-scale fires in the Intermountain West can affect air quality within the area as drift smoke. Recent photographs show the impacts on air quality from catastrophic wildfires in Colorado in 2002. Depending on the fire season, these impacts can be short or long-term. In the case of 2002, several days have been unusually smoky due to large wildfires throughout the West and the lack of reliable prevailing winds (pictures 98-1 thru 98-6).

Depending on the type of grazing management implemented, number of animals, and habitat type, pollution from livestock presence varies. Season-long use and/or heavy use levels can increase bare ground, thereby increasing dust. In periods of drier climate conditions, dust created by livestock trailing, herding, and day to day movements increases.

4) Reference Conditions:

Information gathered from longtime residents has alluded to the increased haziness in the area. Clear vistas were the norm, and being able to see over 100 miles from a high point was an everyday occurrence. At this time, most information is anecdotal since there is very little documentation. Possible causes of this long-term reduction in air quality could be the increased mineral development and associated powerplants to the west that contribute air pollutants. Days that have clear skies are relatively rare.

Historic livestock use tended to be much heavier and for longer periods of time that increased bare ground and decreased plant cover. Large bands of sheep trailed back and forth across the field office, and dust from their movements could be seen for miles.

5) Synthesis and Interpretation:

Current mitigation standards in oil and gas development address new road construction and adequate surfacing. However, many of the existing roads have not been addressed. Vehicular traffic related to increased development results in numerous trips through these areas by anything motorized ranging from ATVs, pickup trucks, semis, large seismic trucks, and miscellaneous heavy equipment. Vegetation along these roads has reduced vigor and production and is generally covered in dust particles. Although gravel on the new roads has reduced some dust problems, even they are not exempt. Winter snows observed from the air show telltale signs of particulate movement along the drift side.

Catastrophic wildfires throughout the West are a problem beyond the scope of this document. Forest fires both regionally and locally could continue to have a significant impact on the area's air quality. Continued efforts to address this widespread problem are being implemented on a national basis, however, in the short-term there will continue to be large-scale wildfires. On the local level, creating fuel breaks and diversifying vegetation communities will help to ensure that wildfires in this area do not become catastrophic in scope.

Best management practices for livestock grazing will continue to reduce particulate pollution caused by this use. Reducing the size of disturbed areas, reestablishing vegetation on disturbed sites, and managing livestock to reduce bare ground will reduce soils susceptible to wind erosion (dust) .

6) Recommendations:

Within this assessment area there is no air quality criteria pollutant non-attainment areas for either state or federal standards as determined by the Wyoming DEQ. Due to prevailing winds, limited pollution within the general area, overall air quality meets this Standard.

Continue to implement mitigation measures on new oil and gas development operations, while attempting to resolve existing issues. Dust abatement due to vehicle traffic is an important concern, both on a resource basis and a public safety basis.

Continue prescribed burning and other vegetation treatment operations to provide for fuel breaks to ensure catastrophic wildfires do not occur. Treatments will greatly reduce the risk of large amounts of particulate matter in the air from local wildfires burning out of control.

SUMMARY

Standard 1 – Watershed Health

Due to the existing diversity and amount of vegetative cover on uplands, the existing and improving trend in stream vegetation and channel morphology, the cooperation exhibited in livestock management by permittees, and the generally small number of management issues still remaining to be dealt with, it is determined that the majority of Upper Muddy Creek watershed is meeting Standard #1. The few locations that do not meet Standard #1 contain large, active head-cuts due to gradient readjustment processes. These areas affect approximately 2,500 acres in Holler Draw and upper Muddy Creek. Current livestock grazing practices are not contributing to the non-attainment of Standard #1.

Due to the existing diversity and amount of vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Barrel Springs Draw watershed is meeting Standard #1.

Due to the existing diversity and amount of vegetative cover on uplands, the existing condition of stream channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the cooperation of livestock permittees in implementing best management practices, it is determined that the majority of the Lower Muddy Creek watershed is meeting Standard #1. The few locations that do not meet Standard #1 contain large, active head-cuts due to gradient readjustment processes. These areas affect approximately 6,000 acres. Current livestock grazing practices are not contributing to the non-attainment of Standard #1.

Due to the existing diversity and amount of vegetative cover on uplands, the existing and improving trend in stream vegetation and channel morphology, the cooperation exhibited in livestock management by permittees, and the generally small number of management issues still remaining to be dealt with, it is determined that the Savery Creek watershed is meeting Standard #1.

Although the existing condition and vegetative cover on uplands could be improved, it is adequate for watershed function. Considering that the number of management issues still needing to be addressed are limited, the existing condition of primarily ephemeral channels, and the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, it is determined that the Little Snake River watershed is meeting Standard #1.

Due to the existing condition and vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Sand Creek watershed is meeting Standard #1.

Due to the existing condition and vegetative cover on uplands, the existing condition of primarily ephemeral channels, the management responsibility by industry and agencies to design and mitigate impacts from roads on hydrologic flow events and soil erosion, and the generally small number of management issues that need to be dealt with, it is determined that the Shell Creek watershed is meeting Standard #1.

Standard 2 – Riparian/Wetland Health

There has been a tremendous improvement in riparian/wetland condition within the assessment area over the last 15 to 20 years. However, there are still areas that need attention. Allotments containing riparian/wetland habitat that do not meeting this standard have been described previously and include: Cherokee, Sulphur Springs, Standard, Rasmussen, Sage Creek, Pine Grove, Powder Mountain, Powder Rim, Cow Creek, Espitalier, Adobe Town, Grindstone Springs, Sand Creek, and Red Creek allotments.

For lotic systems that are not meeting the minimum standard, there are 119 miles out of a total 319 miles. In lentic sites, there are 5 acres of a total 17 acres, that do not meet the minimum standard.

Most of the lentic and lotic sites not meeting the standard have been, or are in the process of being addressed in management plans or as range improvement projects. Continued progress in grazing management of livestock and wild horses (where they are present) will ensure further improvement of all riparian areas within this area. Although there are areas where desired future condition is yet to be reached in woody species dominance and composition in the upper watersheds, these areas still meet the minimum standard of rangeland health. Other than the specific allotments listed previously, the remainder of the allotments within this assessment area are meeting Standard #2 – Riparian/Wetland Health.

Standard 3 – Upland Vegetation Health

At the present, the review of upland vegetation conditions in the upper Colorado River watershed reveals generally good overall community health. Natural ecological and biological processes appear to be functioning adequately overall, although concerns about current, and especially near-future, functionality of certain community types remain. Specifically, the review group has determined that the majority of upland vegetation communities are properly functioning in relation to the seral stage to which they have evolved. Several specific communities, however, elicit concerns due to their uniformity of age and structural class, and the imminent onset of over-maturity to decadence throughout the majority of sagebrush stands, aspen stands, and juniper woodlands in the watershed and mountain shrub stands/mixed sagebrush/mountain shrub grasslands on winter-yearlong and transitional big game habitat.

Specifically, aspen stands throughout the watershed do not meet the standard for upland vegetation health due to decadence and decreasing occurrence and coverage of these stands. Although concentrated at the higher elevations, many of these stands are scattered through lower elevations in more isolated pockets, totaling around 14,000 acres of land within the watershed. The other vegetative community in the watershed that does not meet the standard for rangeland health is mountain shrub, sagebrush, and juniper plant communities located on mule deer crucial winter range between Horse Mountain and Poison Basin along the Wyoming/Colorado state line, and north from Baggs along Muddy Creek. These shrub communities cover approximately 40,000 acres within the watershed. Livestock grazing is a componet in the management scenario of these plant communities, but it is not the principle factor in non-attainment of this Standard.

Standard 4 – Wildlife/Threatened and Endangered Species/Fisheries Habitat Health, Weeds

Habitat needed to support healthy wildlife populations and listed or proposed threatened and endangered species is generally in acceptable condition. This does not mean that there aren't problems or concerns about wildlife habitat. The discussion under Standard #2 – Wetland/Riparian Health and Standard #3 – Upland Plant Health outlines the current conditions and recommendations for improving management of these resources. In many cases we may be meeting a standard but have a ways to go in order to meet our "desired or future" condition. On the other hand, our composition of native species is good, with just spot problems at this time with weeds. Due to the existing good condition of native vegetation and its ability to support the diverse wildlife populations we currently have, it is determined that the majority of Upper Colorado River watershed is meeting Standard #4 with respect to wildlife. The principal area deemed not to be meeting Standard #4 for wildlife habitat is the mule deer crucial winter range located between Horse Mountain and Poison Basin and north from Baggs along Muddy Creek through the Wild Horse and Dad juniper woodlands. This area encompasses about 40,000 acres of public land. The following recommendations address action to help meet future desired resource conditions. Livestock grazing is not a principle factor in the non-attainment of this standard.

The improved management of riparian habitats and successful reintroduction of Colorado River Cutthroat Trout into upper Muddy Creek, as well as other cold water fisheries that exist within the watershed, indicate both an upward trend and meeting Standard #4 for fisheries. However, many other sites that should support fisheries, currently do not. Standard #4 for fisheries is not being met on streams, which currently fail Standard #2 – Riparian/Wetland Health and/or Standard #5 – Water Quality. There are also sites that are rated in proper functioning condition, but due to the lack of overhead cover (stream shading) exceed temperature requirements for some fish species and won't support them. However, these sites have not yet been defined. Due to the lack of credible data on the status of Catostomid and Cyprinid fishes in the watershed, whether Standard #4 is being met for these species is unknown.

Due to the existing good condition of native vegetation and the weed treatment program in place to control and/or eradicate weed problem areas as they are identified, it is determined that the majority of Upper Muddy Creek watershed is meeting Standard #4 with respect to weeds. There are no known areas of noxious weeds that are rapidly expanding and are not being treated. Although saltcedar is not yet being treated on a broad scale, it does not appear to be rapidly spreading to new locations. The few locations that do not meet Standard #4-Weeds are sites containing halogeton in Sand Creek allotment where the weed is invading native rangelands as a result of oil and gas road development and is not being treated. These areas affect approximately 50 acres.

Standard 5 – Water Quality

Within the assessment area, water quality impairment has not been identified by the State of Wyoming for the majority of the area. The following stream segments in the Upper Colorado River basin, which occur on BLM-administered public land, are on the current Wyoming State 303(d) list of impaired waters due to excessive sediment loading:

- Loco Creek (west fork), above the confluence with the main fork, Savery Creek drainage
- McKinney Creek, from confluence with Eagle Creek down to Muddy Creek
- Muddy Creek, from confluence with Littlefield Creek down to confluence with Alamosa Gulch
- Muddy Creek, from confluence with Barrel Springs Draw down to confluence with Little Snake River

The first three sites have livestock grazing identified as an impairment factor and are identified as Class II waters, although they currently do not support cold water fisheries. The last site on lower Muddy Creek has both livestock grazing and oil and gas development identified as impairment factors and is identified as a Class III water. Non-game fish species use it on a seasonal basis. Although specific compliance for the remaining segments is unknown, nothing within available data indicates this Standard is not being met.

Standard 6 – Air Quality

Within this assessment area there is no air quality criteria pollutant non-attainment areas for either state or federal standards as determined by the Wyoming DEQ. Due to prevailing winds, limited pollution within the general area, overall air quality meets this Standard.

Summary of Allotments not meeting Standards due to Livestock Grazing

A. Allotments described in this report that do not meet Standards due to Livestock Grazing:
    - Cherokee: Standard #2 - Riparian/Wetland Health, Standard #5 – Water Quality
    - Morgan-Boyer: Standard #5 – Water Quality
    - Rasmussen Subunit: Standard #2 –Riparian/Wetland Health
    - Standard: Standard #2 – Riparian/Wetland Health
    - West Loco: Standard #5 – Water Quality

B. Allotments described in previous allotment reports that do not meet Standards due to Livestock Grazing:
    - Adobe Town: Standard #2 – Riparian/Wetland Health
    - Beaver Dams: Standard #2 – Riparian/Wetland Health
    - Cow Creek: Standard #2 – Riparian/Wetland Health
    - Espitalier: Standard #2 – Riparian/Wetland Health

- Pine Grove/Bolten: Standard #2 – Riparian/Wetland Health, Standard #5 – Water Quality
- Powder Mountain: Standard #2 – Riparian/Wetland Health
- Powder Rim: Standard #2 – Riparian/Wetland Health
- Sage Creek: Standard #1 – Watershed Health, Standard #2 – Riparian/Wetland Health, Standard #3 – Upland Plant Health, Standard #4 – Wildlife Habitat Health, Standard #5 – Water Quality
- Sulphur Springs: Standard #2 – Riparian/Wetland Health, Standard #5 – Water Quality

Allotments listed in Table #1 of this document, that are not listed in A and B above, either meet all standards or if not meeting one or more standards, it is not due to livestock grazing.

C. Standards not being met due to causes other than livestock grazing:
   - Standard #1 - Head-cuts in the following drainages: Upper Muddy Creek, Holler Draw, Wild Horse Draw, Little Robbers Gulch, Cottonwood Creek; responsibility – BLM.
   - Standard #2 - Riparian/wetland health due to wild horses at the following locations: Kinney Rim Seeps, Moonshine Spring, Grindstone Spring, Hartt Cabin Seep and Artesian Well, Hangout Draw seep, Rotten Springs, Chimney Spring, upper Powder Spring; responsibility – BLM.
   - Standard #3 - Upland plant health in aspen plant communities wherever they occur in the watershed, upland plant health of sagebrush, juniper, and mountain shrub plant communities within mule deer crucial winter range between Horse Mountain and Poison Basin and along Muddy Creek north from Baggs; responsibility – BLM.
   - Standard #4 - Crucial winter range for mule deer between Horse Mountain and Poison Basin and along Muddy Creek north from Baggs; responsibility – BLM. Habitat for fisheries that are listed as impaired on the Wyoming 303(d) list; responsibility – BLM. Expansion of non-native invasive plants (halogeton) into native rangelands due to lack of control from improved roads in the Sand Creek drainage; responsibility – oil and gas industry.
   - Standard #5 - Sediment impairment to Muddy Creek from the confluence with Barrel Springs Draw to the Little Snake River, 303(d) list; responsibility – oil and gas industry.

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